ELECTRICAL REVIEW

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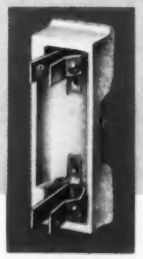

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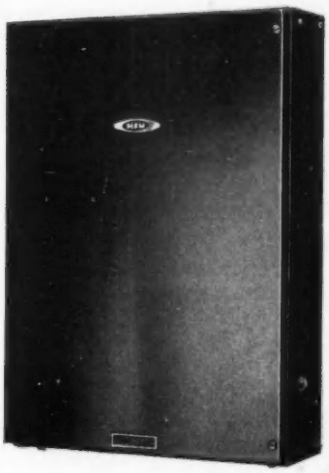

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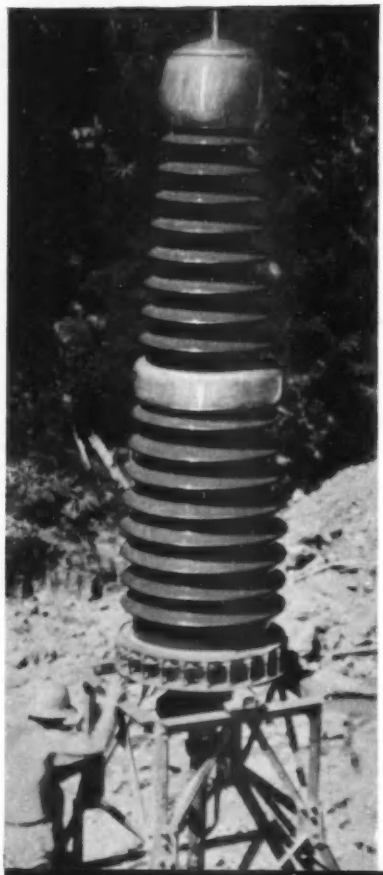

In the Snowy Mountains region of Australia, a great river, the Snowy, and its tributary, the Eucumbene, are being diverted from an easterly course to irrigate the western plains of New South Wales and Victoria. On its journey westward this water will fall more than 2,000ft.—a staggering power potential which, through a chain of hydro electric power stations, will eventually produce enough electricity to pay for the whole vast enterprise. For one of the first of these power stations, the T.1. on the River Tamut, a tributary of the Eucumbene, Pirelli-General have manufactured and installed the highest voltage oil-filled cables ever made in this country. Transmission of power at 330kV. 3 phase 194 M.V.A. (340 amperes phase) along a tunnelled route from an underground generating station to an outdoor switchyard some 1,600ft. distant *on the other side of the River Tamut,*

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proved a formidable undertaking, and the seven cables, all of which were installed in single lengths of 1,625ft. without intermediate joints, were carried on the bridge shown in the photograph. Pirelli-General are proud to announce that their contract to provide a vital link in this great Commonwealth enterprise has now been completed.

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ELECTRICAL REVIEW

20 November 1959 Vol. 165 No. 15 Established 1872

Freedom to Import

SHORTLY before the recent conference in Tokyo of the General Agreement on Tariffs and Trade (G.A.T.T.), the International Monetary Fund announced the unanimous decision of its executive directors that trade discrimination, except against Communist countries, should be abolished with all possible speed. Where a member country's current receipts are largely in convertible currencies, there is no longer considered to be any "balance of payments" justification for discrimination. Similar demands for the proper implementation of the G.A.T.T. agreement were made at the Tokyo meeting. The United States in particular has protested vigorously about the persistence in Europe of discrimination, by means of quotas, against the dollar.

Quotas are a most invidious form of trade restriction and British exporters who have suffered from their effects in Commonwealth and other markets will be among the first to applaud these calls for a freeing of trade. Unfortunately Britain has herself been a principal offender. It was only last week, after twenty years of control, that all types of electrical equipment, except transistors, were freed from quantitative restrictions when imported from the United States and other countries of the dollar area. The level of tariffs is not changed.

The growing number of Continental domestic appliances in the shops is the most obvious indication of increasing foreign competition. In the nine months to September, electrical imports amounted to £28 million, or 36 per cent more than in the corresponding period of 1958. Electronic and communications equipment were the most important group, but imports of motors, switchgear and transformers have nearly doubled. Western Europe provides more than half the electrical goods coming into this country, but the United States, with a total of £8 million, has, despite the restrictions, been by far the largest single supplier.

Now that controls have been removed there will no doubt be some redirection of trade in favour of the United States, but generally higher prices are a major deterrent to any large rise in imports of directly competitive types of equipment. If, as a result, purchases from the United States continue to be concentrated on the more advanced and specialised items, the influence on manufacturers and users would seem to be wholly

beneficial. In fact we have here a clear example of the value of greater reciprocal trade between industrial nations.

For their part, British manufacturers have done well this year in selling to the United States, but the balance in our favour of £3 million is no more than the value of one large shipment of cable. Experience has shown that American firms are not slow to react if they consider too much foreign enterprise is harming their business. The belated relaxation of dollar imports into this country should thus do much to strengthen the hands of those liberal elements in the United States who recognise that the long-term interest of their country, as also of the United Kingdom, lies in the widest possible freedom to import.

APPROVED CONTRACTORS

Nobody knows how many electrical contractors there are in this country. Some years ago the number was put at 10,000 but how this was arrived at is a mystery. The fact remains, however, that anyone can start up in this business without qualification or adequate equipment and this accounts for a great many shoddy unsafe installations and most of the electrical accidents which occur. Even "good" contractors are apt to lapse occasionally from the high standards which they customarily follow, generally because they cannot always supervise their employees constantly.

Thus the work of the National Inspection Council for Electrical Installation Contracting consists not only of approving contractors but also of ensuring that those they have approved continue on the right road. At the end of last March there were 5,250 on the Roll of Approved Electrical Contractors and so it may be presumed that the cream of the industry has already been collected, particularly as the figure includes the membership of the Electrical Contractors' Association. The Council's main task is now to gather in those of, at present, lower status and by doing so continue to raise the standard of installation work.

Success in this aim depends very largely upon the enrolled contractors themselves. Both collectively and individually they must make known to the public and to those responsible for placing electrical work the fact that they are "approved" and why: what the N.I.C. stands for and is achieving.

STEELMAKING EFFICIENCY

The steel industry is perhaps the most important of the basic industries in this country and it may not be generally realised that it is almost entirely dependent on the electrical industry for its efficiency. In a modern steelworks all of the motive power, mechanical handling equipment and even some of the melting are carried out electrically. In fact, a considerable proportion of the cost of a steelworks goes towards electrical plant and equipment.

Since the war there has been a considerable increase in the output of the British steel industry and this has been accompanied by improvements in quality, range of product and operating efficiency. This, to a very large extent, has been due to the great advances in control techniques provided by the electrical engineer. In this issue we publish the first of two articles, by Messrs. J. C. Christie and J. T. Jones, in which details of some of the more important forms of electrical controls encountered in the modern steelworks are given. Although these two articles deal with but a few of the problems which continually arise, they indicate how much the electrical industry has done to bring the steel industry to its present high level of efficiency.

THE FAST REACTOR

The experimental fast breeder reactor at Dounreay, which "went critical" last Saturday, has a most important place in the country's nuclear power programme. A significant element in the estimated cost of electricity to be generated by the power stations now being built for the C.E.G.B. is the credit allowed by the Atomic Energy Authority for the plutonium produced as a by-product. The fast reactor is designed to use this plutonium and the economics of the present thermal reactors are therefore dependent to a large extent on the solution of the many formidable problems that still remain. The drop in the credit allowed for the plutonium is one of the reasons for the revision upwards of the estimated cost of electricity from nuclear stations. Greater confidence in the fast reactor could lead to the A.E.A. allowing a better price.

The decision to start work on the Dounreay plant was courageously taken before Calder Hall had been completed. With such a difficult and advanced project it is not surprising that delays arose in design and construction, and these were further aggravated by the redeployment of key men following the Windscale accident. It is to be hoped that the work will now get the priority that its importance merits. In fact Sir Christopher Hinton has referred to it as the most important of all the development projects which the Industrial Group of the A.E.A. has in hand.

HOMES FOR STUDENTS

The £2 million extension programme started last week at the Loughborough College of Technology is one of the biggest building schemes ever undertaken for technical education in this country. The building project will enlarge the capacity of the College by about 50 per cent and will occupy a site of 44 acres. The new teaching accommodation will be in four main blocks: the workshop engineering block, a science building, an aeronautical/automobile engineering block and a library building. The science accommodation will include separate nuclear energy laboratories. The new union building will provide committee and society rooms, common rooms, a dining room, a cafeteria, a small hall, a games hall, and a fully equipped stage.

The project includes a "students' village" covering some 20 acres. The main aim is to provide living accommodation on a domestic scale and it will be the first of its kind in Great Britain. About 800 of the students will live in the "village" in two- and three-storey terrace blocks and the College's post-graduate students in a new nine-storey block; the "village" will include its own shops. University students should not be forced to live in uncongenial lodgings and the provision of residential accommodation in many universities and technical establishments is long overdue. Perhaps the living accommodation at Loughborough is on rather a grand scale, but it sets an example for future university building schemes.

Electrical Controls in the Steel Industry—1

By J. C. CHRISTIE, B.Sc., A.M.I.E.E.
and J. T. JONES, A.M.I.E.E.*

Fig. 1.—Analogue computers are used to expedite the design of steelworks servo controls

The controls of the rolling and finishing mills are discussed and particular attention is given to Ward-Leonard driving and control of primary mill auxiliaries and screw-downs. The value of the analogue computer in assessing the design of the overall control scheme is also stressed

THE steel industry is unique in that a single works may have an annual output of several million tons which may follow a single production stream for a large part of its progress through the plant. There is therefore almost unlimited scope for the introduction of improved control equipment, offering an increased throughput. However, a few minutes shutdown during the working day due to the failure of an item of control equipment can cost thousands of pounds in lost production; reliability is therefore of paramount importance.

Automatic control has been made possible, first, by the development of components capable of detecting, amplifying and applying the forces needed to effect the controls and, secondly, by the evolution and application of mathematical techniques essential to the satisfactory design of the more complex servo system. The mathematical analysis of these controls has been developed into a tool which enables the performance of the most complex system to be accurately predicted, and this analysis has been taken a stage further in that analogue computers are now available which use simulating circuits linked up to represent the complete servo system.

* English Electric Co., Ltd.

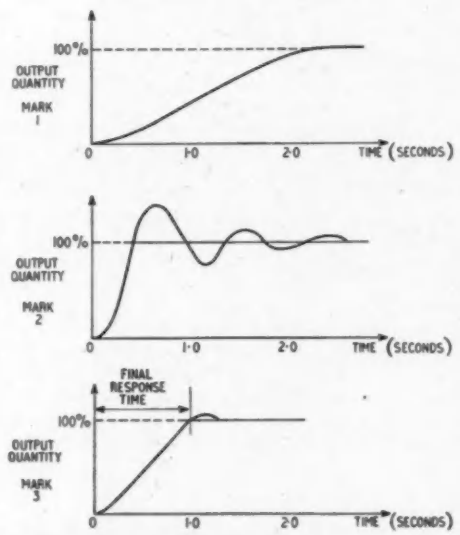


Fig. 2.—Trace from computer shown in Fig. 1: (Top) overdamped system, sluggish performance; (centre) underdamped system, oscillatory response; (bottom) a good compromise

External signals provide inputs which apply either the normal or disturbance conditions which can be expected, and the results can be recorded either permanently by pen recorder or transiently by cathode-ray oscilloscope. These results can then be translated into the effect of various operational conditions on the full-scale system.

Fig. 1 shows an analogue computer which is used to expedite the design of servo controls on steelworks drives, while Fig. 2 shows traces obtained with three possible designs for the response to a step input of reference.

In addition to saving considerable design engineering time the computer can take into account non-linearities which would make the mathematical analysis impracticable. The net result is a more accurate prediction of site performance which enables the best system to be chosen.

While a great variety of electrical drives are used in the iron- and steel-making sections of a steelworks, these are mainly for the bulk handling of materials, and are ancillary to the main process. Here the on-off type of control is normally adequate, and details of this less specialised type of control are omitted from these articles to enable greater emphasis to be placed on the rolling and finishing sections.

Rolling and Finishing Mills

The arrangements of rolling mills and the associated finishing plant vary considerably with individual works and the class of product in which they specialise. Fig. 3

shows the general production flow line through the various stages of rolling and finishing. The diverging routes taken by the different end products are typical only and many variations of these exist.

Steel always arrives in the rolling shops as cast ingots, and after reheating each ingot is first rolled in a primary mill which may produce slabs or blooms. From there the hot steel may pass through various hot continuous or reversing mills and then possibly cold-rolling mills until it reaches its finished state as plate and sheet, sections, or one of the many other products of the particular works.

Each type of mill has its own characteristics and may require control of varying form, with emphasis on speed of response, accuracy of speed control, control of tension or any other variable which may affect the process involved. In the subsequent paragraphs the controls for the main types of mill are considered in detail.

Hot Reversing Mills

Every rolled product of the steel industry passes through one or more hot reversing mills. Where the cross-sectional area of the metal is large and its length relatively short it is convenient to pass it backwards and forwards through the same mill a number of times. For this type of rolling the metal must be around 800°C to 1,200°C. Hot reversing mills fall into the following categories:—Primary mills which receive an ingot in the form in which it was cast in the steel-making shops; plate mills, which reduce the reheated slab to the final dimensions required for such uses as ships' plate, atomic reactor vessels, etc.; section mills which transform the bloom into the various sections of structural steel, railway track, etc.; and roughing stands for strip mills, which further reduce the thickness of the reheated slab before it is passed on to the continuous finishing stands.

On the larger hot reversing rolling mills it is becoming common to use two motors, one directly coupled to each roll, so avoiding the need for gearing, and using motors within the limits of normal design. In the example chosen here each motor has an r.m.s. rating of 6,000 h.p. over a speed range of 50 to 80 r.p.m., with a working peak torque of 2½ times and a cut-out peak torque of three times the r.m.s. value. One of these drives is shown in Fig. 4. The motor on the left drives the top roll by means of the shaft passing over the other motor. The control equipment for the motors has been designed to enable them to reverse from base speed to base speed in one second, despite their size.

The rolling direction and speed of the mill is under the complete control of the mill driver, who sits in a pulpit overlooking the mill. The control scheme is arranged so that the mill responds faithfully to each movement made by the driver on a controller, which is usually foot-operated.

The fast, accurate response of the mill to the movements on this controller is obtained by the use of high-power-gain servo control of the voltage of the four Ward-Leonard generators needed to supply the two motors, and of the field current in the two motors. These controls are subject to over-riding current limit which allows the armature current to rise just to the safe working peak.

The essentials of the primary mill control are shown in the simplified diagram, Fig. 5. This uses a combination of magnetic amplifiers, operating at 400 c/s, to give high amplification and negligible time delay, and fast-response exciters. Amplifying control exciters are not always necessary; the present trend is to omit them.

The first movements of the controller from its centre-off position cause increasing current in the reference winding of the generator magnetic amplifier (GMA). The corresponding rise of generator voltage is fed back to the reset winding on the amplifier which is connected to oppose the reference winding, so that under steady-state conditions the net excitation is the small difference needed to maintain the generator excitation. On the instant of application of reference current to the amplifier no reset signal is available, and so the amplifiers develop full output, giving full excitation on the main generator exciter (GE). The armature of GE provides a considerable forcing voltage to the fields of the four generators, causing their output voltage to rise rapidly to the point when the reset excitation on the magnetic amplifier almost balances the reference voltage. Movement of the controller through the centre position causes the reversal of the reference voltage, so that the generator volts are forced to zero and then raised to the required value in the reverse direction.

If the full forcing were applied to the generators, particularly with the mill on load, the accelerating current might

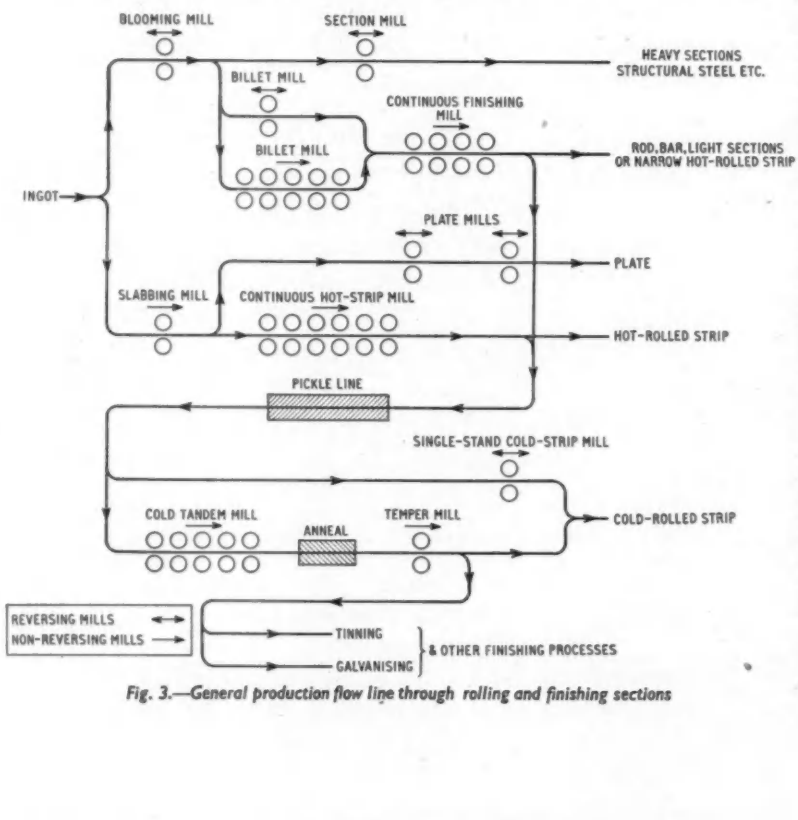


Fig. 3.—General production flow line through rolling and finishing sections

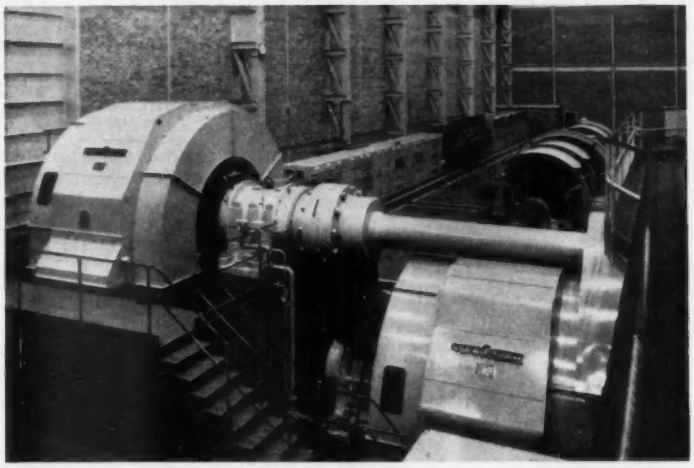


Fig. 4.—The two 6,000 h.p. motors for individual drive to the rolls of a hot reversing mill

cause overloading of the motors. To prevent this, a voltage proportional to the armature current of the generators is detected across their compoles. When this voltage exceeds the voltage of a bias in the circuit, the excess is applied to a further winding on the magnetic amplifier which opposes the reference. For the duration of the load the effective reference is reduced and overloading is prevented. Normally, the current-limit circuit is set to operate at 2½ times full load current and to hold the speed down against full reference at three times full load current.

The motor field range is applied on the further movement of the controller. Here the reset signal is of motor field current and any difference between this and the reference signal is amplified through the motor magnetic amplifier MMA, the motor control exciter MCE and the main motor exciter ME.

The sequencing operation is arranged so that there can be no field weakening until base speed is reached, and conversely no alteration of armature voltage is possible unless the mill motors are at full field.

On many mills a reversal time of 1·5 to 2 seconds is perfectly satisfactory; provision is made for adjusting the responses by means of an exciter voltage limit which operates in a manner identical to the current limit. A low setting of this exciter limit slows down the response by limiting the forcing voltage available. Both the generator voltage and motor field controls are provided with this feature.

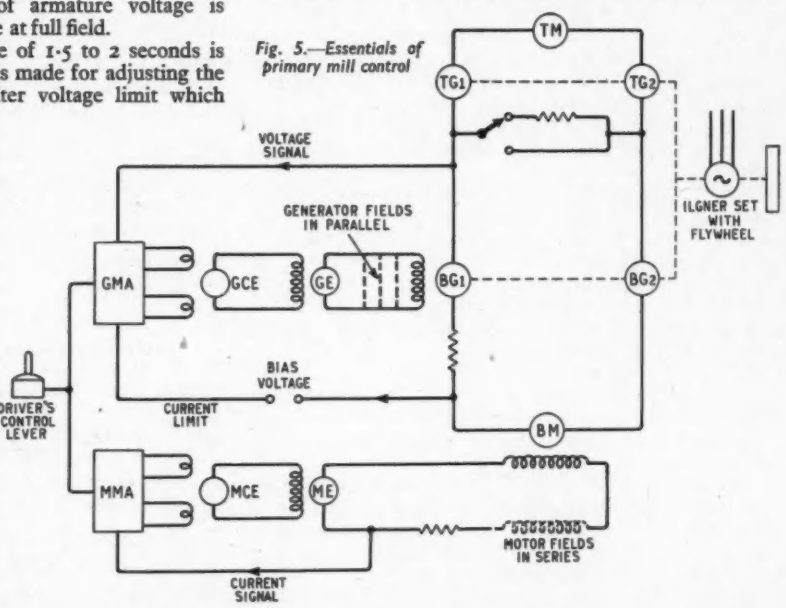
The motors and generators are connected in series with the generators interposed between the two motors to give the minimum voltage between any points in the circuit. Torque and speed balance are maintained by means of a "mid-wire resistance" or a solid mid-wire link, which counters transient unbalanced currents and provides an automatic correcting action for current and voltage differences between the top and bottom loops.

When one motor (usually the bottom one) takes more current on heavy drafts, the metal is turned either up or down, making handling difficult or damaging the rolls. The shape of the metal must be controlled, using torque control of one roll relative to the other by altering the voltages of the top and bottom generators; this produces a speed differential and hence a torque differential. With the mid-wire resistance a large difference in generator voltage is necessary to achieve a speed differential. With the solid mid-wire, however, the adjustment of generator voltage is much more sensitive and effective, but there is no inherent transient tendency for the loops to equalise. The choice of link to use is left for the mill operators to decide after satisfactory rolling has begun.

To reduce the time for tilting the slab for an edge-on pass, edger rolls are sometimes added before a primary mill as shown in Fig. 6. This not only increases the output tonnage (by reducing the number of passes required) but smooth edges are obtained and the edger rolls remove scale from the side surfaces of the material. Basically, the edger control is very similar to the main drive, with an independent generator voltage control of the main drive. However, since an edger is often coupled to the main mill through the hot material a loose speed tie is required between the two sets of rolls. The edger generator is therefore designed to have a "soft" characteristic to allow its motor to follow the main mill irrespective of roll settings and drafts. If the power of the edger motor is sufficiently large (up to, say, 4,000 h.p.) fairly heavy reductions may be taken, though usually their power is less than this.

While the mercury arc convertor has found many applications on relatively constant voltage duties, its use in the field of hot reversing mills has been severely limited

Fig. 5.—Essentials of primary mill control



due to its lack of regenerative features. The first hot reversing mill in this country to use grid-controlled convertors was commissioned only a year ago.

For reversing mill drives mercury arc convertors can be used instead of m.g. sets, in order to gain from the inherent advantages of the device.

Among the many difficulties to be overcome is that a mercury arc convertor can pass current in one direction only. Thus, on reversing-mill duty considerable kinetic or rotational energy has to be absorbed from the motor armature to reduce the speed quickly. This means that a reversal of armature current is required, and special arrangements have to be made to make the motor brake economically.

Operation with a convertor scheme causes harmonics to be fed into the supply system, and repeated load changes are reflected almost directly into the mains,

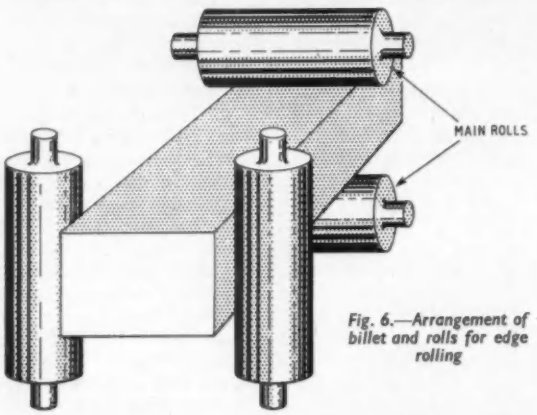


Fig. 6.—Arrangement of billet and rolls for edge rolling

causing fluctuations in voltage. The solution to the former is to provide an adequate number of phases and in the matter of supply voltage variations each local power system must be carefully considered.

Primary Mill Auxiliaries

The great power, fast response and rapid reversal time of the primary mill is of little consequence unless the time taken in delivering the ingot to the mill, handling it between passes and finally delivering it to the slab yard is reduced to the minimum. Even with the fastest handling of the ingot and slab the period when the mill is actually rolling may be as low as 40 per cent of the total time.

The auxiliaries associated with a slabbing mill would normally include: the ingot buggy for conveying the ingot from the soaking pits to the mill tables; the roller tables on either side of the mill which carry the ever-increasing length of metal as it passes back and forth between the rolls in its transition from ingot to slab; the manipulators which position the metal to enter the rolls correctly and which may turn it on its side for an edging pass; the screw-downs which move the top roll up and down to give the required roll opening for each pass; the runout tables which convey the slab to the shear and then on to the slab yard; and the slab shear which crops the slab ready for the next rolling stage.

The closed loop Ward-Leonard control system for auxiliary drives is particularly adaptable to the special requirements of controls on the ingot car, screw-downs and slab shears, etc.

The ingot car which transports the ingot to the mill rolls may have to travel up to 1,000ft from its loading point at the soaking pits. Even at maximum speed this would take over one minute. Shuttling arrangements have therefore to take full advantage of the latest controls to ensure maximum speed and minimum travel time over the distance, bearing in mind that the car plus ingots may weigh over 120 tons.

Closed-loop current control provides tension in the winch-hauled ropes, while generator voltage limitation allows the maximum motor speed to be attained, subject to an over-riding position control system which monitors the relative positions of the car and its terminal. The car can thus be positioned either at the mill or at any one of the pits selected by the operator from his production schedule. When the operator presses his "run" button the car accelerates to its maximum speed, the tension on the ropes is held steady by the current control, and by using the position device troublesome and often unreliable track switches can be eliminated. Special circuits prevent deceleration until the correct distance has been travelled, thus ensuring the optimum operating conditions compatible with safety.

Screw-Downs

On many slabbing mills it is normal to turn the slab on its side and roll the sides to the correct width and squareness once or twice during the reduction. For this edging pass the rolls may have to lift some 60in and then return for the next pass which is perhaps 12in. The problem on the screw-down drive is therefore that of obtaining a very rapid acceleration and high speed for edging-pass settings and yet ensuring accurate positioning. In short, the rolls may have to move at 10in/sec and yet must be set for finishing passes to an accuracy of $\frac{1}{16}$in or less.

A typical Ward-Leonard screw-down drive circuit is shown in Fig. 7. This arrangement has two 200 h.p. mill-type machines, specially constructed to stand up to the arduous steelworks duty, connected in series sandwich with their respective generators. The latter, as on many auxiliary drives, are on different m.g. sets so that in the event of failure one set can be shut down, but continuity of operation is maintained at a slower rate.

A 400 c/s magnetic amplifier and exciter are used for each generator voltage control, the value being selected by the controller in the hands of the pulpit operator. A current-limit feature is provided, the signal being effective when the current rises above twice full load current. If the current rises to 2·5 times full load current, the effect of the current limit is to reduce the reference field down to a stall value, should the operator hold his controller over under a heavy sustained load, e.g. a mechanical seizure. The operating characteristic is as shown in Fig. 8.

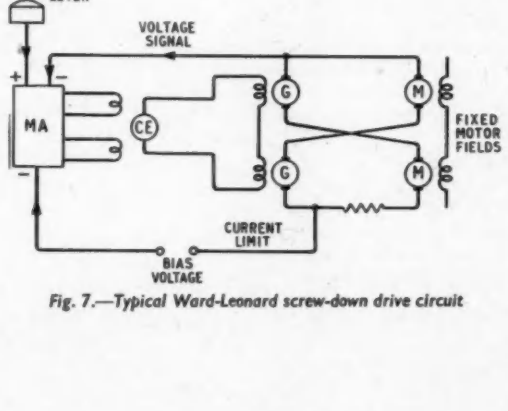


Fig. 7.—Typical Ward-Leonard screw-down drive circuit

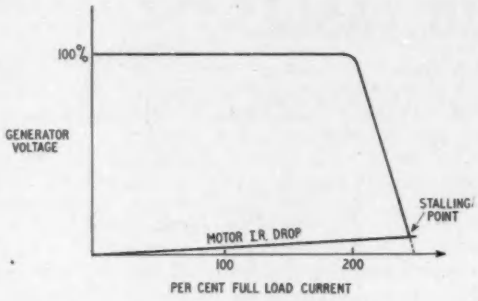


Fig. 8.—Operating characteristic for screw-down drive

Normally on an auxiliary drive the inertia of the load relative to the motor capacity is much higher than on larger equipments and so the current-limit feature is usually the factor which determines the speed of response and the reversal times. One advantage of this type of control is that during speed changes the system is held in current limit effectively and efficiently, thus providing for optimum operating conditions. The high-frequency magnetic amplifiers allow a fast response but, more important with the advent of truly automatic working, their low power-input requirements are a great advantage.

Slab Shear

When the slab has been finally rolled and passed over the run-out tables it has to be cut up into 6-10ft lengths to facilitate further handling. The cross-section of the material may be up to 60in × 10in, i.e. 600 sq in, and the shear has to accelerate, cut and brake in a cycle time that will keep up with the mill.

Ward-Leonard control similar to that previously described for the screw-down drive is used, but because an extremely high peak cutting torque may be required at the shear crank, some assistance is required from the kinetic energy of the moving parts if a reasonably-sized motor is desired. Thus, enough droop is built into the Ward-Leonard loop to allow the motor and the rotating parts of the shear to give up their energy during the cut.

From here the slabs are reheated before passing to the next stages of reduction.

MARINE ALTERNATORS

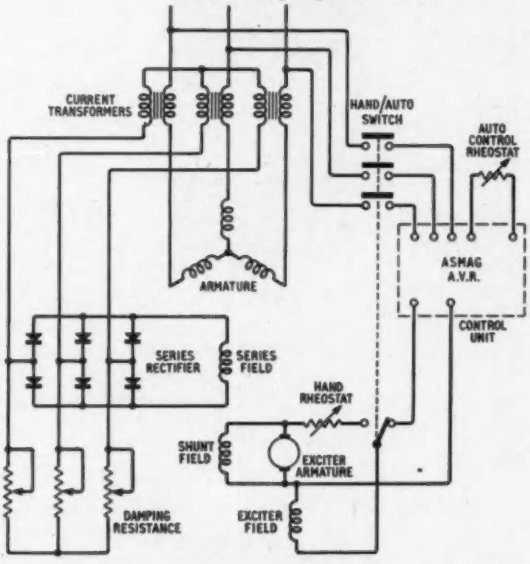
NEW SELF-REGULATING SYSTEM

OWING to the relatively high starting current drawn by squirrel-cage motors and the isolated nature of the supply, voltage regulation of marine alternators is a major factor influencing their design. The transient voltage regulation for ships' alternators is the factor limiting the size of the induction motor which can be switched direct on the line. A voltage drop of 20 per cent of the normal value is regarded as the maximum permissible. To increase the size of induction motors which can be supplied by an alternator, the alternator size can be increased relative to the prime mover. The right approach, however, is to improve the inherent self-regulating characteristics of the alternator itself.

The most straightforward system both in theory and operation is to use a compounding system similar to that of a compound-wound d.c. generator. Such a system is based on the use of static excitation control equipment in conjunction with an alternator having two separate windings. The "Altoreg" alternator manufactured by Laurence, Scott & Electromotors, Ltd., is a compounded machine following conventional lines. Depending on the steady-state voltage accuracy and the transient response time specified, electro-mechanical or "Asmag" magnetic amplifier voltage regulators are applied. Thus, an "Altomag" equipment which is the combination of an "Altoreg" alternator and an "Asmag" magnetic amplifier voltage regulator will have a steady-state voltage regulation of between ±1 to 2½ per cent as required, a transient voltage change at 0 to 0·4 p.f. lagging of 15 per cent with 100 per cent load and a response time for restoration within 3 per cent voltage of 0·5 to 1·5 sec as required. A schematic diagram of such an arrangement is reproduced. The main field winding is series excited and the auxiliary field is fed from a separate source, in this case a pilot exciter.

For outputs up to approximately 150 kVA, four or six pole, the "Altoreg" type alternator can be supplied as a self-excited unit having an inherent steady-state voltage regulation of 5 to 7½ per cent. This machine is of the salient-pole, rotating armature type, the initial build-up of voltage being obtained by a simple reconnection of the shunt and/or series field windings, usually by a relay. If greater accuracy of voltage control than is given above is required, a conventional automatic voltage regulator can be added in the shunt winding circuit of the alternator.

Schematic circuit diagram of "Altomag" alternator equipment with separately excited "Altoreg" alternator and magnetic amplifier automatic voltage regulator



HIGH-VOLTAGE OIL-FILLED CABLES

330 kV INSTALLATION FOR SNOWY MOUNTAINS HYDRO-ELECTRIC AUTHORITY

A substantial contract for the manufacture and installation of 330 kV oil-filled cable has recently been completed by Pirelli-General Cable Works, Ltd., for the Australian Snowy Mountains Hydro-Electric Authority. The cable design is described and particulars are given of the type tests to which it has been successfully subjected. A general description of the installation work undertaken in Australia is also included

THE installation of the 330 kV oil-filled cables for the T1 generating station of the Snowy Mountains Hydro-Electric Authority in the Tumut River Valley, Australia, has just been completed by Pirelli-General Cable Works, Ltd., an associate of the General Electric Co., Ltd. These are the highest-voltage cables to be designed and manufactured in this country, and the company is believed to be the first British cable maker to complete successfully a commercial installation for this voltage.

Pirelli - General 330 kV oil-filled cable

Transmission of 194 MVA at 330 kV three-phase (340 A per phase) along a tunnelled route from an underground transformer hall to an outdoor switchyard some 1,600ft away has proved to be a formidable undertaking. Apart from the obvious technical problems, many other difficulties were involved such as extreme climatic conditions, a difference in level of over 200ft between terminals, and an undertaking to install these large cables in single lengths of up to 1,625ft without intermediate joints.

The seven cables and their associated accessories were manufactured at the Eastleigh Works of the company and installed under the supervision of their contract engineers. The design of the accessories was undertaken by the Pirelli S.p.A., Milan. The type of cable installed takes the form of a copper conductor laid up over a central duct formed as a spiral of aluminium wire of about 0·192in diameter, the cross-sectional area of the conductor being 0·325 sq in.

The maximum working stress is 130 kV/cm and an electrostatic screen of carbon black papers is provided over the conductor and also over the insulated core. The paper-lapping process is carried out on a machine capable of applying up to 200 papers with mechanical precision and accurately controlled tension, enabling the cable to be insulated in a single pass through the machine. The machine is housed in an air-conditioned enclosure held at low relative humidity to ensure uniform shrinkage in the paper tapes during the subsequent drying process. The cables are lead sheathed and suitably reinforced to withstand the high internal oil pressure. The lower ends of the cables are, for the same reason, provided with longitudinal reinforcement. Anti-corrosion protection is provided overall.

At the station end of the route each cable had to be taken vertically downwards into an oil-filled connecting chamber forming part of its associated main transformer tank. The cable at this end was, therefore, fitted with an oil-immersed terminal capable of withstanding a continuous pressure of 110 p.s.i. Mechanical stability of the insulation for operating in the inverted position was assured by the provision of epoxy resin supports. Epoxy resin stress control components were also incorporated and resulted in a considerable reduction in the size of the unit, with consequent economy in the design of the transformer connection tank. The outdoor terminal is 11ft from the base plate to top extremity. The porcelain insulator is in two parts which are connected by means of an electrically screened mechanical joint. The internal design of this terminal is in other respects conventional.

The suitability for service conditions of the system components was demonstrated by comprehensive development tests and finally by subjecting a representative installation to a very searching series of type tests. The official type test installation consisted of 100ft of production cable cut into two halves terminated respectively with an outdoor type and an oil-immersed sealing ends and jointed with a straight-through joint. Before assembling, the cable used for the type test was subjected to a bend test of four reverse cycles round an 11ft diameter former.

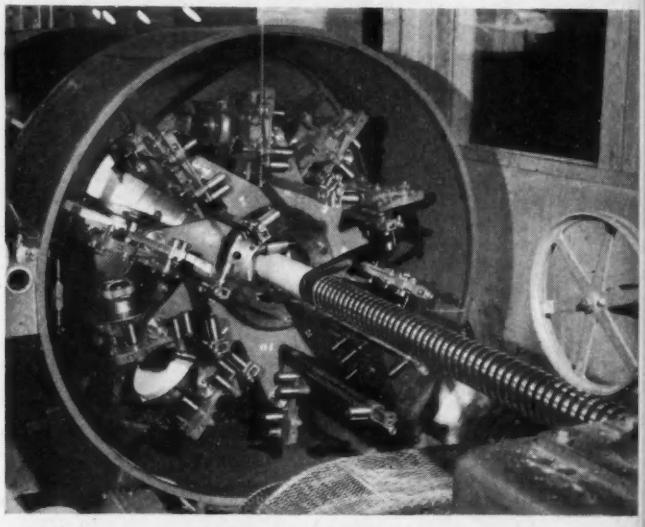
It may be of interest to describe the principal tests in the order in which they were carried out. First, there was the impulse test which was a withstand test at the

specified level of 1,300 kVp at 85°C nominal temperature (actual 95°C) and with a wave shape of 2·3/55 μsec. Next followed a 24 hr a.c. test at 475 kV (2·5 times working voltage) at ambient temperature. The object of this test was to prove that the first impulse test had not caused any damage to the insulation.

The loading cycle and thermal stability test involved twenty daily cycles of 8 hr heating to 85°C and 16 hr cooling to ambient. A voltage of 286 kV (1·5 times working voltage) was applied continuously and power factor measurements were made daily. At the end of the load cycle test the loading current was adjusted to obtain steady temperature conditions of about 90°C. This current was thereafter maintained constant for 6 hr and the perfect stability of the system demonstrated by the unchanged values of temperatures and power factor values.

The outdoor sealing end was then subjected to an average rate of precipitation of 0·15in/min (water resistivity of 10,000 ohm/cm) and a 30 sec withstand test at the specified value of 533 kV. Then the second impulse test was performed. This was a withstand test at the specified level at 85°C nominal temperature (actual 95·5°C). A 15 min a.c. test at 381 kV (twice working voltage) followed. The final impulse test involved raising the impulse voltage in steps of 50 V from the specified withstand level of 1,300 kV. Breakdown occurred at 1,500 kV, corresponding to a conductor stress of just over 1,020 kV/cm. A series of d.c. tests were carried out on a second assembly to prove the soundness of design of the transformer entry chamber into which the oil-immersed sealing ends are fitted. Complementary tests included hydraulic tests at twice working pressure on cable and accessories, tests on cable serving and measurement of cable dielectric thermal resistivity.

The seven cables, which ranged in length between

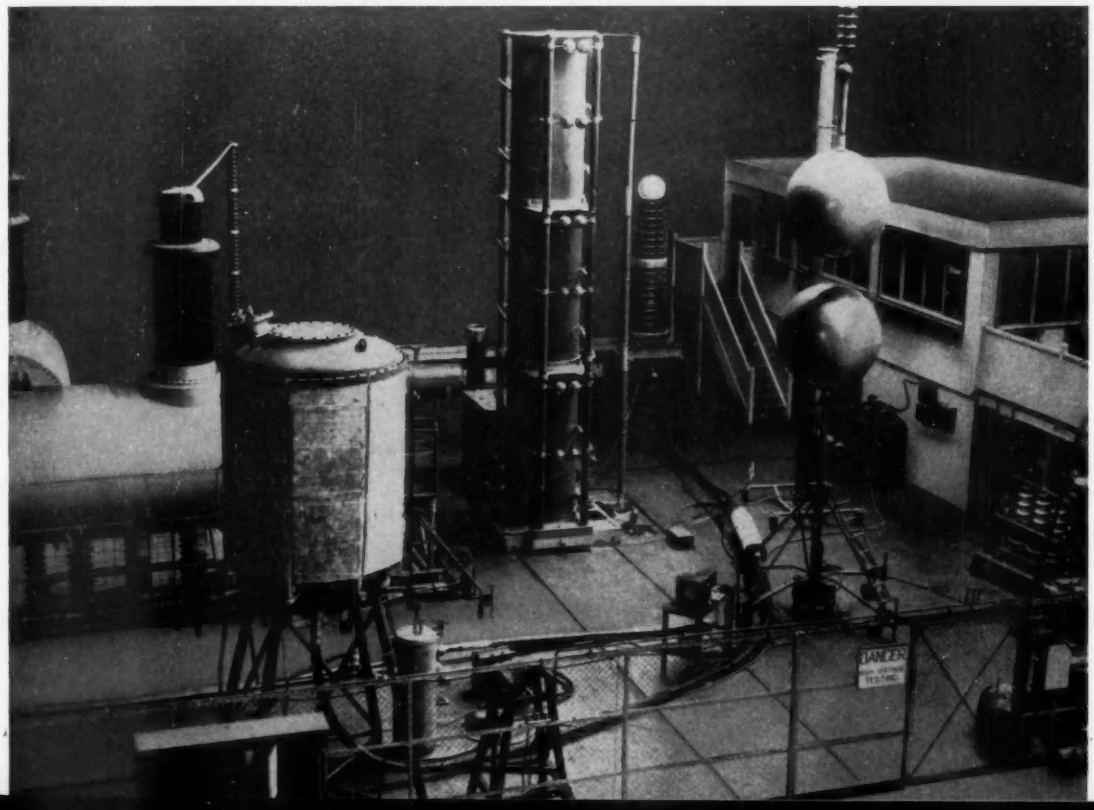


Carbon loaded and metallised paper screening tapes being applied to a 330 kV oil-filled cable on the Pirelli-General specially enclosed lapping machine

507 yd and 543 yd, were pulled from the switchyard end and laid at 1ft centres in sand-filled troughs in the floor of the tunnel. The sand was specially selected so that its thermal resistance, even when dry, ensured the requisite heat dissipation at the maximum cable loading.

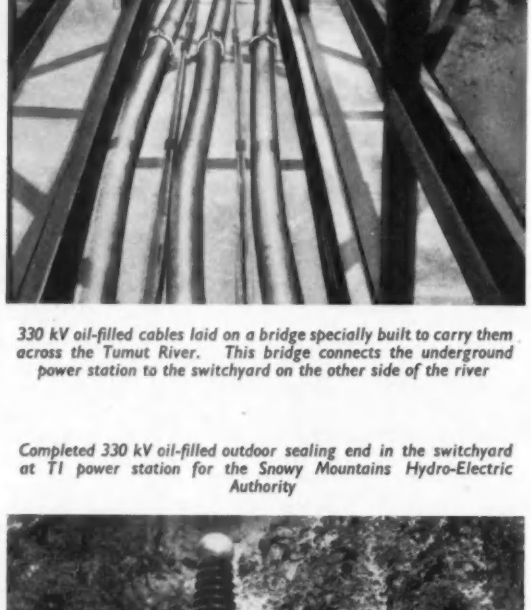
As the switchyard is on the opposite side of the Tumut River to the power station a special bridge had been built over the river to carry the cables. The seven cables were cleated to the bridge on continuous supports, allow-

330 kV oil-filled cable type test arrangement in the high voltage laboratory. The arrangement includes a straight joint, outdoor sealing end and oil-immersed sealing end



330 kV oil-filled cables laid on a bridge specially built to carry them across the Tumut River. This bridge connects the underground power station to the switchyard on the other side of the river

Completed 330 kV oil-filled outdoor sealing end in the switchyard at T1 power station for the Snowy Mountains Hydro-Electric Authority



ance being made for the expansion movements of the cable due to load and to seasonal temperature variations. The assembly of the outdoor terminals in the switchyard and the connections to the oil-feeding pressure tanks presented no special difficulty, but the insertion of the oil-immersed terminals in the transformer connecting chamber involved considerable problems in manipulation. The connecting chambers were filled with oil degasified on site to a condition similar to the oil contained in the cable.

After the installation each phase and its associated terminals was tested at 760 kV d.c. using a one million volt d.c. mobile test set designed and manufactured for Pirelli-General by Ferranti, Ltd. Following the test, the transformer connecting tank was emptied, the temporary test barriers below the terminal removed, the transformer connector fitted and the tank again filled with degasified oil.

E.R.A. Reports

TWELVE papers on "Climatic Conditions and Equipment" were presented at the first session, under the chairmanship of Mr. H. Astbury, at an International Symposium on "Electricity in the Tropics" held in Paris in May, 1956. As the general report and the report of the discussion, together with the papers themselves, would occupy a considerable volume, Report Ref. CL/T1, "Summary of Proceedings at International Symposium on Electricity in the Tropics. 1. Climatic Conditions and Equipment," by M. E. Thompson, price 30s, has been prepared. It comprises summaries of the papers, and résumés of the general report and the discussion. A second report on the other meetings is in course of preparation.

Cable Heating

The problem of the transient temperature rise due to a line source in a semi-infinite medium with a radiation boundary condition at an interface parallel to the line source, is the basic difficulty involved in the calculation of underground cable ratings for intermittent loads. This is solved in the report, Ref. F/T194, "Heating of Cables: Transient Temperature Rise Due to a Line Source in a Semi-Infinite Medium with a Radiation Boundary Condition," by H. Goldenberg, price 7s 6d. The deviation between this solution and the solution subject to an isothermal boundary condition at the interface is clearly specified. Neher's formula for the steady-state temperature is obtained as an approximation. An example is given showing the ratio of transient to steady-state temperature rise at the upper surface of a cable laid direct in the ground, under each of the two assumed boundary conditions.

Vacuum Switching

The history of the vacuum switch is briefly reviewed in Report Ref. G/XT161, "Circuit Interruption in Vacuum," by M. P. Reece, price 7s 6d, and the fundamental processes of arcing and arc extinction in vacuum described. Finally, some indications are given of the possible applications of the vacuum switch to the control of a.c. power.

Limited supplies of these reports are available, at the prices indicated, from the Publications Sales Department of the Association at Thorncroft Manor, Dorking Road, Leatherhead, Surrey.

Supply Industry Finances

FURTHER COMMENTS ON THE ANNUAL REPORTS

By
D. J. BOLTON, M.Sc.(Eng.), M.I.E.E.

The author examines the finances of the Electricity Boards both collectively and individually, and endeavours to assess their economic progress

THE annual reports of the Electricity Boards serving England and Wales, which were reviewed in the *Electrical Review* of 2nd and 9th October, are of particular interest for the light they throw on the financial state of the industry. To the onlooker, wishing to take a quick look at the supply industry's economy, two questions are of paramount importance, namely—has the price of electricity been kept down, and have the Boards made a profit (or at least avoided a loss)? If the answer to both questions is in the affirmative he will probably be well satisfied with the year's results.

On the basis of this superficial appraisal the industry can be said to have had a good year. Almost all the Area Boards have kept their prices steady (the mean selling price throughout the country has risen only by about 1½ per cent), while for the first time for some years every Board, both generation and distribution, has achieved some degree of surplus. Before being satisfied with this result, however, it is necessary to look a little deeper to see whether the future has been adequately provided for, and in particular to examine the reserve position.

Depreciation Provision

A new departure is announced in the provisions for depreciation of generation assets. In the past, assets of all kinds have been depreciated chiefly according to the character of the asset itself, and the (minimum) length of life which it can be presumed to have. Thus, a substantially constructed building of brick or concrete used as a power station or substation would be given a life of 40 years even though the plant it contained would require renewal in a shorter time and would be provided for in a shorter period.

This is no longer a realistic assumption in the case of large generating units having low capital costs per kilowatt since it is not normally economic or practicable to put larger sets in the buildings which house the plant to be replaced, or to use the cooling water facilities that were suitable for that plant. The Generating Board has, therefore, adopted a single life of twenty-five years for all conventional power stations, and the same thing for main transmission substations, many of which are situated at power station sites. Other assets have been grouped in wider classes, taking, in general, the shortest life previously used for assets in that class. Area Boards' assets are not affected by the new arrangement and these Boards continue to use the life periods adopted when the industry was nationalised.

The chief changes are summarised in Table I, which also shows the change in the annual allocation required expressed as a percentage of the previous allocation and based on the straight-line method used by the Boards. These changes are not all in the same direction, but they resulted in the addition of nearly £6 million to the Generating Board's depreciation charges in 1958-59. The new rates have been applied (with effect from 1st April, 1958) to all assets acquired since 1948. The assets created before that date, where not already fully amortised, are still being depreciated over the lives adopted by the former undertakings.

As regards nuclear stations the Board has decided to adopt a life of twenty years, but as provision for depreciation does not start until the year in which the first generating set of a station comes into operation this decision has not yet been applied.

One result of the trend towards much larger generating units having lower costs per kilowatt is that the age-old problem of whether to provide for depreciation on the basis of historical cost or replacement cost has been given a new twist. Provision on the latter basis, usually more expensive, might now well prove to be the cheaper of the two. The position is enormously complicated by the fact that plant is rarely replaced by similar sizes and types of plant and, of course, when conventional plant is to be replaced by nuclear there can be no question of depreciating the former on a replacement-cost basis. The extra cost of atomic power stations, though it may ultimately be recouped through lower running cost, must in the meantime require additional capital.

It will be noted that what are called "economies of scale" which have lowered the cost per kilowatt of recent conventional power stations do not apply in any marked degree to distribution assets. Distribution is a diffused

TABLE I.—CHANGES IN LIFE PERIODS ASSUMED FOR PURPOSES OF DEPRECIATION PROVISION

	Life period (years)		Proportional change in depreciation provision
	Old	New	
Conventional Power Stations and Main Transmission			per cent
Land	No provision	25	
Buildings and Civil Work	40	25	+ 60
Cooling Towers—Concrete	30	25	+ 20
—Timber	15	25	− 40
Underground Mains	40	30	+ 33
Hydro-electric Power Stations			
Land	No provision	60	
Buildings	40	60	− 33
Civil Work	80	60	+ 33
Nuclear Power Stations			
Land, buildings, plant and initial fuel charge.	No arrangements	20	
Freehold Property other than the above			
Land	No provision	40	
Administration buildings	60	40	+ 50
Short-term Assets			
Batteries, office machinery	7	5	+ 40
Instruments, vehicles, furniture and portable equipment.	10	5	+100

TABLE II.—BULK SUPPLY TARIFF CHANGES

Operating from	Standing Charge		Running Charge			
	Per annum per kW	Change (per cent)	Basic		Fuel-cost Variation	
			Pence per kWh coal at 60s	Change (per cent)	d. per kWh per 1d per ton	Change (per cent)
1/4/52	£4 5 6	—	0·515	—	0·0007	—
1/4/54	£4 15 0	+11·1	0·50	−2·9	0·00065	−7·2
1/4/55	£4 15 0	—	0·50	—	0·0006	−7·7
1/4/56	£5 0 0	+ 5·3	0·50	—	0·0006	—
1/4/57	£5 10 0	+10	0·47	−6·0	0·0006	—
1/10/57	£6 0 0	+9·1	0·47	—	0·0006	—
1/10/58	£6 0 0	—	0·46	−2·1	0·0006	—
1/4/59	£7 2 0	+18·3	0·41	−8·7	0·00055	−8·3

rather than a concentrated process and does not so easily lend itself to the use of bigger and bigger units. Moreover, although since the war the proportions of capital investment in generation and distribution have strongly favoured the former, even now less than half of the total capital assets consist of power stations. If, therefore, prices in general continue to rise there is little hope that the industry as a whole will be able to replace conventional plant at a lower cost per kilowatt, quite apart from the inevitably higher cost per kilowatt of nuclear plant.

Other Reserves : Scope for Self-Financing

Apart from depreciation provision (which, being on a fixed scale is, in a sense, automatic and not open to variation) the general reserve position disclosed by the reports may be described as adequate, though by no means ample. In the last five years a sum of about £10 million has been set aside annually in a special reserve towards the additional cost incurred in replacing assets at higher price levels. Each year there have also been small allocations to a Central (now termed "Generating") Reserve Fund and an Area Reserve Fund. Taken altogether, the above allocations, together with unappropriated balances, have never exceeded 5·7 per cent of the year's revenue and have averaged only 4·2 per cent of revenue over the last five years. The small margin of receipts over expenses which has enabled these reserves to be built up can certainly not be regarded as excessive.

Since allocations to reserve, whether for depreciation or other purposes, are not invested externally but remain within the industry, their accumulation can be used to finance new purchases in lieu of additional borrowing. If the supply industry remained constant in size over a very long period, if it never made use of any new techniques, and if all plant prices remained steady, the depreciation reserve, if the correct lives were used, would supply all capital needs subsequent to the initial loan. Fortunately, these static—not to say stagnant—conditions do not apply, and hence the industry can furnish only a part of its capital needs from its internal resources. In the year under review the proportion was about 42 per cent and it is expected to rise to slightly over 50 per cent in 1964-65.

Generating Board Results

The results reviewed above have referred to the industry as a whole. When these are broken down, and a separate assessment is made (or attempted) of the generation and distribution sides, the position is not so clear-cut. It is true that all the Boards publish separate accounts and that in the past year these have each shown a greater or less degree of surplus. But the economics of the two sides of the industry are inextricably bound together, the bond between them being the bulk supply tariff. Even a minor variation in this tariff would be sufficient to turn surplus into deficiency either for the Generating or the Area Boards.

The real test of the financial progress of any Board is not its annual surplus (which is relatively easily secured in the case of a near-monopoly like electricity) but its success in keeping down the price of what it sells in relation to the prices of what it buys. The Generating Board buys (or hires) coal, plant, capital and labour, and it sells bulk supplies. The Area Boards buy bulk supply, plant, capital and labour and sell electricity to the consumer. How do the two sets of accounts look from this point of view?

Figures for the bulk supply tariff in recent years are shown in Table II, with the percentage variation each time the tariff has been changed. It will be seen that the general trend has been in the direction of a higher kilowatt charge and a lower running charge, due to increasing capital charges on the one hand and increasing generation efficiencies on the other. A welcome break in the former has been the reduced cost per kilowatt of the very large sets recently installed, and it is good news that in spite of the higher depreciation allocations referred to above, the Board hopes to hold the bulk supply tariff at the 1959-60 level at least until 1961-62.

So far as coal price increases are concerned the Board is covered by the price adjustment clause, and the increases are passed on automatically to the Area Boards. As regards the other two major elements in the tariff, since one has gone up and the other down, the only way of finding whether the tariff as a whole has risen or fallen is to examine the overall price per kWh at one given coal price.

Fig. 1 plots the three components of the bulk supply tariff in the form of a pence-per-kWh charge, the vertical scales being broken so as to exaggerate the changes. The height of the middle curve shows the combined effect of the kilowatt charge and the running charge with coal at 60s per ton, and it will be noted that in the first four years plotted (from 1952-53 to 1955-56) this total was approximately constant whilst in the last three years it has risen somewhat.

The top curve shows the actual bulk supply charge in this pence-per-kWh form and this has risen steadily

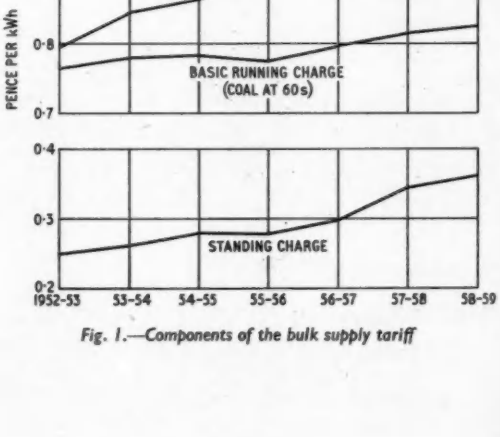


Fig. 1.—Components of the bulk supply tariff

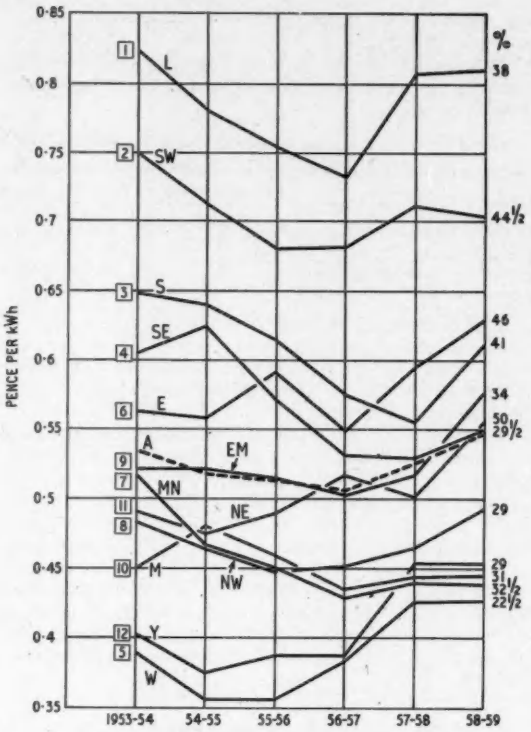


Fig. 2.—Area Boards' distribution costs over six years

Curve A (dotted) is the average for all Boards; curves for the individual Boards are indicated as follows:— L, London; SW, South Western; S, Southern; SE, South Eastern; E, Eastern; EM, East Midlands; MN, Merseyside and North Wales; NE, North Eastern; NW, North Western; M, Midlands; Y, Yorkshire; and W, South Wales. Figures in squares on left show the 1953-54 cost sequence given in I.E.E. paper. Figures on the right of the curves give percentage of domestic sales of each Board.

during the period illustrated. Actually, the curves slightly understate the rise since they include the effect of load factor which has improved somewhat during the period. It will be seen that, even apart from the increase due to fuel prices, the Board has not been successful in holding down its tariff. Further than this it is difficult to go in assessing the Board's economy, and as there is only one such Board it is not even possible to carry out a comparative study such as can be done with the Area Boards.

Area Board Comparisons

In assessing an Area Board's financial progress one must confine one's attention to the sector over which the Board has control, namely, the cost of distribution. The best measure of this is the difference between the cost per kWh at which the Board buys (i.e. the overall bulk supply charge) and the cost per kWh at which it sells (i.e. the mean revenue per kWh sold). This difference includes not only the Board's working expenses but also the cost of the distribution losses and the incidence of the allocations to reserve and the annual surplus, together with the Board's contribution to the expenses of the Electricity Council. Since, taking one year with another, the Board has to cover all these items in its charges to consumers they may collectively be regarded as the real cost of distribution.

The results are best shown graphically, and in Fig. 2 the distribution cost as defined above is plotted for the last six years as an average for the whole of England and Wales (dotted line, A) and also separately for each of the twelve Area Boards. (For greater emphasis the zero has been suppressed.) The curve of average cost falls slightly but steadily for the first four years and then rises rather more steeply for the last two years. There is a slight similarity to the middle curve of Fig. 1 and probably similar factors affected both sorts of Board.

The individual results show a total range of about two to one, with the London Board easily the most expensive, followed at a respectful distance by the South Western Board. South Wales and Yorkshire had the lowest costs in the earlier years, but have now been caught up by the Midlands and Merseyside Boards.

It would be a rash and invidious task to attempt to explain these differences, but one or two clues may be suggested:—

(a) Geography, or more precisely, latitude. Most of the upper part of the figure is occupied by Boards in the southern half of the country whilst Boards in the north and the industrial Midlands occupy the lower half. (Exception: South Wales.)

(b) Domestic load. (This is, of course, linked with factor (a).) The figures on the right of the curves give each Board's percentage domestic sales in 1958-59. Six of the Boards have domestic sales of less than one-third, and these all lie in the lower part of the figure.

(c) There is no doubt that some Boards manage to operate with a consistently greater economy than others. In an earlier attempt (on quite different lines) to assess relative distribution cost* the results showed a considerable measure of agreement with the above. In order to illustrate this agreement the cost sequence of the English and Welsh Boards in 1953-54, as determined in the paper referred to, is given in squares at the left of each line, and except for South Wales the correspondence is remarkably close.

Load Factor

Considerable attention is paid in the reports to the question of load factor and the efforts which the Area Boards are making towards its improvement. The actual system load factor fluctuates from year to year, being artificially raised by any form of load spreading or shedding and being depressed when the winter is exceptionally severe. This is because a cold spell tends to increase the demand by a bigger proportion than it increases the annual consumption. By making allowance for these fluctuating elements the adjusted load factor proves to have been constant at about 46½ per cent for the last four years. In the previous six years, i.e. from 1948 to 1954, it appears to have risen by about 4 per cent although there is bound to be some uncertainty regarding the adjustment to be made during the load restriction period.

Neither the magnitude nor the increase can be considered satisfactory or as affording grounds for complacency in view of the heavy demands which the industry makes annually on the country's investment resources. When the load factor is split into its component parts it becomes clear that its lowness is chiefly due to two factors, the night/day ratio (daily load factor about 70 per cent) and the summer/winter ratio (0·6 to 0·65). The former can be improved by shift working in industry and by the encouragement of night storage heating. The latter calls for a new approach to the type of winter heating which so easily becomes cold-spell heating.

* *Proceedings:* Institution of Electrical Engineers, Vol. 102, Part A. "A Criterion of Distribution Cost."

Comparisons with other countries can be illuminating provided due allowance is made for differences of climate and industrial time tables. In parts of America, for example, the summer/winter ratio may be greater than unity when the air-conditioning load exceeds the electric heating load, and this helps in securing load factors of the order of 60 per cent which are commonly achieved.

Conditions more nearly comparable to those of the United Kingdom are probably to be found in Western Germany, and in this connection great interest attaches to the results of the German supply system for 1958.* The load factor calculation is not based on a factual maximum demand of the year but on a "notional" figure taken on the third Wednesday in December, the date at which the year's peak has commonly occurred. On this basis it appears that system load factors were reached in 1957 and 1958 of 55½ per cent and 58½ per cent respectively, whilst the corresponding load factors on the generating stations were 58 per cent and 62 per cent.

When the load factor is analysed it becomes evident that it is the better summer/winter ratio which chiefly accounts for the factor being so much higher than that of the United Kingdom. In Fig. 3 the daily load curves on the bulk supply system of England and Wales are given for 14th January, 1959 (the peak day for 1958-59) and for a typical summer day in 1958. These are reproduced from the first report of the Electricity Council (pages 8 and 9). On the same graph, using dotted lines, are shown December and June day load curves for the West German system (Fig. 19 of the article previously quoted). All the curves are scaled per cent of the winter peak demand of the system concerned, and the daily load factors of the two peak days are approximately: England and Wales, 71 per cent; West Germany, 73 per cent. The graphs show clearly that whilst the German daily load curve is little better than the English one, and shows hardly any more sign of shift working or night storage, the summer load is proportionally much higher than it is in this country.

In searching for the reasons, Table III shows the proportions in which the consumption is made up in the two countries.

* "Electricity Supply in the Federal German Republic in the year 1958." *Elektrizitätswirtschaft*, 20th July, 1959.

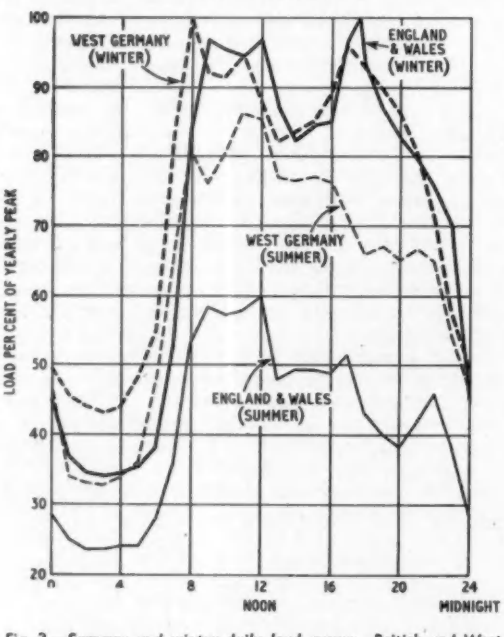


Fig. 3.—Summer and winter daily load curves—British and West German

TABLE III.—ANALYSIS OF ELECTRICITY CONSUMPTION IN ENGLAND AND GERMANY

Class	England & Wales	West Germany
	per cent	per cent
Industrial and Traction	51	65
Domestic	33	16
Farm	2	3
Commercial and Public Lighting	14	16

The outstanding difference is that the proportion of domestic consumption is more than twice as great in England as it is in Germany, and much of this difference must be attributed to the comparative insignificance of domestic electric heating in the latter country.

The mere fact that a notional peak day load provides a reliable basis of calculation shows how little the German peak is dependent on the vagaries of the weather. In order to find a parallel in this country one must go back many years to the time when there was no substantial electric space-heating load and when the annual peak occurred year after year round about the last full working day before Christmas. Since then we have managed to acquire a cold-season load which is in no small measure responsible for depressing the annual load factor and preventing the fullest utilisation of the capital equipment.

Joint Consultation

AN article, "Ten Years of Development," by Mr. D. G. Dodds, industrial adviser to the Electricity Council, forms an introduction to the annual report for 1958-59 of the National Joint Advisory Council for the Electricity Supply Industry. "An experiment in human relationships," he states, "has now become an established feature of our industry. Its future success depends on active thinking, mutual goodwill and mutual respect."

The report, which as usual is well illustrated and attractively presented, surveys the work during the year not only of the National Council but also of the District Joint Advisory Councils and the Local Advisory Committees. The National Council made a further sixteen recommendations to the Electricity Council, making a total of 176 since the Council's inception. They agreed to sponsor a university scholarship scheme for school leavers and recommended revisions to the rules of the employees' suggestion scheme to improve its operation.

The District Joint Advisory Councils spent much of their time discussing education and training matters and considering questions of efficiency and safety. There are now 484 Local Advisory Committees in the industry, most of them based on power stations or distribution districts, and they meet at least every two months. Copies of the report can be obtained from Mr. M. Skinner, secretary of the N.J.A.C., Winsley Street, London, W.1.

Radiation Course

THE first advanced course in radiation protection commenced on 28th October and continues until 26th January at the Harwell Reactor School. This course is intended for both new graduate entrants to health and safety work in the atomic energy field and those already engaged in this work who have the required academic background. The course deals with fundamental principles rather than with particular techniques and consists of lectures, practical work and visits. It is expected that further courses in advanced radiation protection will be held, the fee for which will be £250 exclusive of accommodation.

VIEWS on the NEWS

By REFLECTOR

ALL progress means that somebody is left behind. The extent of the damage done to established interests depends upon the degree to which they are able to adapt themselves to altered conditions. I am led to this thought by a report in the *Observer* of a revolt of coal merchants against the too-hasty institution of smokeless zones. Their principal arguments are that local authorities are able to make their own decisions in this matter when they should be guided or controlled by a central body; and that the establishment of too many smokeless zones would cause the demand for smokeless fuel to outrun the supply. One answer to this is that electricity stands ready to remedy any shortage and, of course, there are other less convenient substitutes. After all, the creation of smokeless zones merely means a speeding-up of a process which has been going on for many years now: the replacement of raw coal by cleaner and more manageable derivatives.

* * *

Most people are aware that some electrical concerns have unusual, but presumably profitable, sidelines. For instance, a well-known cable-making company produces soldering irons and once upon a time also made waffle irons. Another company whose main business is the production of plastic mouldings for radio and electrical purposes does a good trade in lavatory seats. Yet another has quite a large output of tumblers from its glass works which is ordinarily engaged in making lamp bulbs and tubes. In this same connection I have just seen in *Topic*, the newspaper of Associated Electrical Industries, Ltd., an advertisement offering employees sets of wine glasses and tumblers from the Chesterfield Glass Works of the A.E.I. Lamp & Lighting Co.—and quite handsome shapes they are.

* * *

I see from a note in *Public Service* (the official journal of the National and Local Government Officers' Association) that in some circumstances power station clerks are paid "plusages." A correspondent to the journal points out that at the last N.A.L.G.O. conference it was decided that the Association should try to "put paid to plusages." At the same time it should kill this word and substitute an English one.

* * *

This country's experience in the matter of coal—serious shortage foreseen about three years ago, followed by fears that the Coal Board will now never dispose of all the coal it mines—is paralleled in a way in New Zealand. A year ago, the *New Zealand Electrical Journal* says, there was an acute shortage of power in the North Island and proposals were made to intensify development of the South Island's resources and transmit power to the north by a cable across the Cook Strait. Since then it has been found that the geothermal power available in the North Island will meet the deficiencies and so the Cook Strait link is not to be carried out immediately, although the Minister of Works has said that "the ultimate objective of linking the Islands is being kept in view and investigational work is proceeding." In somewhat the same way the rate of provision of nuclear power in this country has been slowed down.

* * *

According to a news item in the *South Western Star*, thieves recently stole £20 in cash from an electricity meter in a house at Wandsworth. If there are many prepayment meters with such a hoard—400 shillings—it explains the famine of these coins which people complain about. Incidentally, this particular consumer must find it quite a problem obtaining the four to five shillings a day he needs—presuming that the meter was emptied at the usual quarterly period.

* * *

For this week's glimpse of the past I turn to the *Electrical Review* of 24th November, 1899. In this issue there was reproduced the presidential address to the Institution of Electrical Engineers, and the President was the redoubtable Professor Silvanus P. Thompson through whose hands passed many future leaders of the electrical industry. Professor Thompson spoke at length on the role of the Institution in the profession, the industry and in national affairs, and then reviewed the state of electrical practice at that date. It was the time when the electricity supply system was really in its infancy. Professor Thompson said:—

> "In the public distribution of electric energy for lighting and power the necessities of economic working are effecting a slow but sure revolution. The methods that were in vogue at the date when the Electric Lighting Act of 1888 made electric distribution in this country commercially possible are being superseded. Larger generating units are being used in our stations. Larger areas of supply and fewer generating centres in an area are a necessity of the time. From the row of little bipolar dynamos, each with its own small high-speed engine—a sight so familiar in the older lighting stations of this country—we are gradually passing to the use of large multi-polar machines coupled to larger and more economical steam engines. Ten years ago a distribution at six miles from the generating station was looked upon askance by many electrical engineers. Today it is recognised that the secret of economical work is to generate on the large scale—'in bulk' as the phrase goes—and to distribute over large areas at an appropriately high voltage."

Insulator Performance in Polluted Atmospheres

Summary of a paper entitled "Research on the Performance of High-Voltage Insulators in Polluted Atmospheres" presented by J. S. Forrest, M.A., D.Sc., M.I.E.E., P. J. Lambeth, B.Sc.(Eng.), A.M.I.E.E., and D. F. Oakeshott, B.Sc., A.M.I.E.E., at a meeting of the Supply Section of the Institution of Electrical Engineers on 18th November

THE insulation of high-voltage systems presents an unusually difficult problem in Great Britain owing to the combined effects of the very humid climate and high density of industry with consequent pollution of the atmosphere. Thus, many flashovers of 132 kV lines and substation insulators occurred in the early years of the grid system. Research on the problem started by the Central Electricity Board and continued to the present day, has yielded much useful information resulting in improved service performance of insulation. Flashover due to industrial and saline pollution still occurs, however, sometimes with serious consequences, on the 132 kV and 275 kV networks. For example, approximately 0·6 faults/100 route miles occur annually on the 132 kV grid, of which 40 per cent are due to industrial and 60 per cent to saline pollution.

Industrial pollution should decrease in future but, as more generating stations are sited on the coast, trouble from salt may present an increasing problem. Furthermore, the use of higher transmitting voltages not only increases the insulation difficulties but makes the consequences of flashover more serious. Thus, it has been necessary to conduct research on insulators for use at 132 kV and 275 kV where many problems still require solution, and also at 380 kV as a prospective transmission voltage.

Method of Evaluation

To evaluate the performance of an insulator, it is energised for a long period at maximum service voltage in the polluted atmosphere of the Croydon Insulator Testing Station: the leakage current is recorded and any flashover noted. The performance is then evaluated primarily in terms of the time to flashover and, when necessary, of the number of leakage-current surges in a given period. Investigations into the effect of insulator shape and dimensions confirmed that leakage path length is the predominating factor in determining the performance of conventional porcelain or glass insulators. Insulator diameter has only a second-order effect.

The performance of porcelain or glass insulators can be greatly improved by applying various treatments to make the surface water-repellent and of high resistance under all conditions. Thus, coating insulators with thick hydro-carbon greases has given good results, both in investigations at Croydon at all test voltages, and in service. The surface soon becomes extremely dirty through adherence of grime to the surface, but the grease engulfs this pollution and good surface properties are maintained. A coating of thick grease will be satisfactory for two years. A water-repellent surface is obtained also with oil-bath insulators, experience with which at 132, 275 and 380 kV has been quite good. They have been found to be vulnerable to coke dust pollution, however.

Another and very effective way of improving the performance of porcelain insulators is to use a semi-conducting ceramic glaze to control voltage distribution. Unfortunately, deterioration can occur rapidly under pollution conditions through removal of the conducting components of the glaze, and this has been shown to be an electrolytic process. Nevertheless, many resistance-glazed sealing ends and other insulators of a near-cylindrical shape have given more than 10 years of satisfactory service. A new barium ferrite glaze has been developed, which laboratory tests have shown to be more corrosion-resistant.

Various line and post insulators developed for 380 kV have been energised at Croydon for three years, and some of these types should be suitable for operation in this country.

High-Voltage D.C. System

Outdoor line and station insulation for high-voltage d.c., associated with the cross-Channel link, has been tested for two years at Croydon, using 115 kV d.c. Dust precipitation on surfaces at or near earth potential by the electric field determines the *initial* dirt distribution, but in a few weeks' time, normal weathering and redistribution of the stress brought about by the deposits themselves results in a nearly uniform fouling. Leakage-current surges occur with d.c. just as with a.c. and, generally, the predominating factors in insulator performance appear to be the various surface heating and drying effects. About 30 per cent more insulation seems to be required for high-voltage d.c. than for a.c. of the same peak voltage.

The natural pollution test takes several months, and to give more rapid results an artificial salt-pollution test is being developed. In this, the surface deposits are built up as in service, with the normal working voltage applied to the insulator. A spray of salt solution is blown in a special wind tunnel on to the insulator and its performance observed. Promising results have been obtained and further development of the technique is in progress.

A.S.E.E. Diploma Examinations

THE Executive Council of the Association of Supervising Electrical Engineers announces that the 14th annual examinations to be conducted under the A.S.E.E. Diploma Scheme will take place at various centres throughout Great Britain on 24th, 25th and 26th May, 1960.

In the light of modern industrial needs and educational development, the Association has found it necessary to re-appraise its examination requirements and the 1960 examination is likely to be the last to be held under the current syllabus and regulations. It is not, however, intended to alter the basic object of the A.S.E.E. Diploma Scheme, which is to encourage and reward the endeavours of those who desire to advance in the electrical industry. Entrants to the A.S.E.E. Diploma examination are eligible for the premiums made from time to time to candidates obtaining examination results of a high standard.

The latest date for receipt of applications to enter the 1960 examinations is 15th March next. Further details may be obtained from the General Secretary, Association of Supervising Electrical Engineers, 23, Bloomsbury Square, London, W.C.1.

ELECTRICAL INDUSTRIES BALL

LAST Friday evening about a thousand people attended the annual ball in aid of the funds of the Electrical Industries Benevolent Association. They were received by the President, Sir Leslie Gamage, and the Hon. Lady Gamage.

The customary telegram had been sent to the Queen, the Association's patron, and during dinner the President read Her Majesty's reply. Deprecating speech-making at such a function, Sir Leslie briefly commended the work of the E.I.B.A. and Lady Gamage reinforced his appeal for a generous contribution to the funds.

After dinner, dancing proceeded until 2 a.m. on Saturday and during a break Donald Adams and Thomas Round, of the D'Oyly Carte Opera Company, gave excerpts from Gilbert and Sullivan operas, and the "Cavalcade Girls" danced most vivaciously. Another popular item was the draw for a wide variety of prizes which had been given by 45 electrical concerns. The programmes were presented by Associated Electrical Industries, Ltd.

As a result of the ball the Association's funds will benefit to the extent of about £2,100.

AT LAST FRIDAY'S ELECTRICAL INDUSTRIES BALL

1. Mr. H. Senior Fothergill (secretary, E.I.B.A.) with the President, Sir Leslie Gamage, and the Hon. Lady Gamage. 2. Mr. and Mrs. W. J. Bird, Mr. and Mrs. W. Lewis Smith and Sir Leslie and Lady Gamage. 3. Mr. D. E. Beavan's table. 4. Mr. J. Bennett's table. 5. Dr. T. E. Allibone (immediate past-president) and guests. 6. The President's table. 7. Sir Alexander Sim was host of this group. 8. Guests of Mr. W. J. Bird

Letter to the Editor

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Keeping the Pot Boiling

I HAVE read with particular interest the reference by "Reflector" in the *Electrical Review* for 30th October to the need for some simple means of keeping a kettle just at boiling point. There is, of course, a very simple solution, and one which I have applied for some years, in the shape of what I can only consider to be probably the best value for money of any electrical gadget ever devised.

I refer to a device which gives a variable degree of "on" and "off" running, and which in fact was originally intended for the very object which "Reflector" has in mind, i.e. to produce a simmering effect in a cooking unit.

I have a simmering control of this kind, assembled in a very robust unit, having a socket outlet in the body of it and a cable with a plug at the feeding side. It is therefore quite simple to put this device in series with the kettle in one's sitting room and plug into the appropriate socket outlet.

I have also found it an excellent way of controlling an iron which has no thermostat; in fact, I venture to suggest that this has some advantage over the iron with an in-built thermostat as it may provide a more robust form of control than can be incorporated in the iron itself. The fact that it is not calibrated in "temperature" is of little consequence because the housewife can soon find the setting for different categories of ironing.

Walberswick, Southwold. C. A. CAMERON BROWN.

Dounreay Goes Critical

THE fast breeder reactor at Dounreay "went critical" (i.e. started producing energy) on Saturday and will go through a period of low power operation for some time. Announcing this the United Kingdom Atomic Energy Authority states that this period may be followed by a shut down for modifications and the reactor will then be worked up to power in stages.

Construction work on this reactor started in May, 1955, and it was scheduled to start operation last year. Because of the redeployment of staff due to the Windscale pile incident and to certain design modifications, start up has been delayed. In the early stages the Dounreay experimental reactor will be operated to provide information on the physics and control characteristics of this type of system, and this will be followed by a stage of intensive development and testing of different types of fuel elements. From this experience much help will be derived for the design of a prototype fast power reactor, the next stage of development.

The Dounreay fast reactor, which was described fully in the *Electrical Review*, 17th May, 1957, consists of a central core of enriched uranium surrounded by a "blanket" of natural uranium. A proportion of the neutrons produced in the nuclear reaction make their way into the blanket where they produce plutonium, which can be used in the core to produce more heat and more plutonium. Experiments have shown that the amount of fissile material produced in the core and the blanket during operation will exceed the amount burnt up in the core, and the reactor is thus a "breeder." The neutrons in this reactor are said to be "fast" because they are not slowed down by a moderator as in the thermal reactors.

Heat is removed by placing the core and blanket in a stainless steel vessel filled with liquid metal, sodium-potassium alloy. This is circulated by electromagnetic pumps through 24 heat exchangers arranged radially around the vessel. Non-radioactive liquid metal in the secondary circuit is pumped to a heat exchanger house where steam can be produced to drive a 15 MW turbo-alternator. The reactor with its primary heat exchangers is installed in a concrete vault within the 135ft diameter steel sphere which dominates the site.

Looking down on the stainless steel pressure vessel which contains the reactor core and "blanket"

Enamelled Copper Conductor

THE range of British Standards for enamelled winding wires has been extended with the publication of B.S. 3160: Part 1 : 1959 "Enamelled copper conductors (enamel with polyester base), Part 1: Round wire," to include enamels based on terephthallic acid polyester resins, which are generally suitable for higher operating temperatures than those of the polyvinyl acetal type covered by B.S. 1844. The requirements in the standard are similar to those specified in the first part of B.S. 1844 but some of the test temperatures are 30-50°C higher. The range of wire sizes standardised extends from 0·002in to 0·16in diameter. Four standard thicknesses of covering are provided over most of this range. Copies may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 8s 6d.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The Secretary of State for Scotland has reappointed **Sir John Pickles,** B.Sc., M.I.E.E., as chairman of the South of Scotland Electricity Board for the period from 1st January, 1960, to 31st December, 1963. The Secretary of State has also appointed **Sir David Anderson,** Ph.D., A.R.C.S.T., F.R.S.E., M.I.Mech.E., to be a part-time member of the Board for the period from 1st January, 1960, to 31st December, 1962, in place of **Sir John Imrie,** C.B.E., whose present appointment terminates at the end of this year.

The Minister of Power has appointed **Mr. E. J. Lollar,** B.Com., A.C.A., Companion I.E.E., to be a member, with effect from 1st January next, of the Merseyside and North Wales Electricity Board while continuing to serve as a full-time officer of the Board. Mr. Lollar has been chief accountant of the Merseyside and North Wales Electricity Board since 1948 and was formerly chief accountant of the Mersey Power Co., Ltd., becoming a director and assistant general manager of the Mersey Power Co. and the Mid-Cheshire Electricity Supply Co., Ltd.

Sir Henry Self, K.C.B., K.C.M.G., K.B.E., who recently retired from the chairmanship of the Electricity Council, was the guest of honour at a dinner given on 12th November at Grosvenor House, Park Lane, London, by past and present members and officers in the electricity supply industry. The dinner was presided over by Mr. C. R. King, C.B.E., chairman of the Council, and presentations were made to Sir Henry and Lady Self by Lord Citrine, P.C., G.B.E., and Lady Citrine on behalf of many of Sir Henry's senior colleagues.

Mr. I. M. Milsted, B.A.(Cantab.), A.M.I.E.E., has been appointed manager of the Government and Railways Department of the General Electric Co., Ltd. He joined the company in 1930 and in 1939 began specialising in Admiralty affairs. During the war Mr. Milsted served in the Navy and rejoined the G.E.C. in 1946, taking charge of the Admiralty Section of the Government and Railways Department.

Mr. I. M. Milsted

Mr. G. J. Masters

Mr. G. J. Masters, M.C., who has been appointed deputy manager of the Government and Railways Department of the G.E.C., joined the company in 1932 and was appointed to the Department in 1939. During the war he served in the Army and became officer commanding, 64th Field Regiment, R.A. (T.A.) in 1946. He returned to the G.E.C. Government and Railways Department, specialising in Ministry of Supply and War Office affairs.

Mr. C. F. Boyes has been appointed manager of the Central London Area branch of the G.E.C. and **Mr. F. H. Farthing** has been appointed manager of the South Eastern Area branch.

Mr. C. F. Boyes

Mr. F. H. Farthing

Mr. Boyes joined the company in 1926 as an apprentice at the Magnet Works. In 1929 he transferred to the Sales Department at the Birmingham branch and in 1937 moved to the company's head office. From 1939 to 1945 he served with the Army in the Royal Artillery, becoming a major on the Staff. On demobilisation he returned to the G.E.C. Sales Department as supervisor of Area Board sales, South of England, later becoming assistant manager of London sales.

Mr. Farthing joined the company in 1917 and, after working for three years as a trainee at the old headquarters in Queen Victoria Street, was appointed to the G.E.C. of China, Ltd., Hong Kong. He returned to this country because of ill-health and joined the Export Department at the Witton Engineering Works and in 1930 moved to the head office where he worked for a number of years in the Marine Sales Department. In 1935 he was appointed manager of the G.E.C. showrooms. Mr. Farthing served with the R.A.F. during the war, attaining the rank of wing commander. On his return to the G.E.C. he worked for a few months in the Lighting Department and then joined the London Sales Department with special responsibility for co-ordinating the company's business with I.C.I. In 1956 he was appointed manager of the Brighton branch. Mr. Farthing was hon. secretary of the Electrical Industries National Golf Championship for six years.

Mr. S. B. Warder, chief electrical engineer, British Transport Commission, is to visit Bombay, Calcutta and New Delhi in December, at the invitation of Indian Railways, to give lectures on British Railways' electrification programme, in the course of which he will tell Indian railway officials how Britain can help them not only with technical advice but by supplying electrical equipment. Mr. Warder is flying to India on 26th November. While in New Delhi he will attend a meeting of the Permanent Commission of the Railway Congress Association who will be discussing problems met in the design of multi-current rolling stock. Mr. Warder is due home by Christmas.

The Minister for Science has appointed **Professor C. F. Carter** to be a member of the Council for Scientific and Industrial Research. He takes the place of **Professor E. A. G. Robinson,** who retires on completion of his period of service. Professor Carter is Stanley Jevons Professor of Political Economy and Cobden Lecturer in the University of Manchester.

Mr. G. Lloyd Jones, manager of the Cardiff district office of the British Thomson-Houston Co., Ltd., has retired. He received his early training and technical education at Bangor and after service in France during the 1914-1918 war joined the B.T.H. Co. (Rugby Works) for a special course of training leading to a staff appointment as a commercial engineer in 1922. In 1926 he was transferred to the company's Middlesbrough district office, being appointed manager in 1936. He was appointed manager of the Cardiff office in 1954.

Mr. G. Ll. Jones

Over 450 young engineers from the **English Electric Co.'s** Stafford works have received awards and indentures in recognition of good work and progress during apprenticeship training this year. Presentations were made by Sir George Nelson, chairman of the company, at the Borough Hall, Stafford, on 13th November before an audience of parents and friends. Sir George was introduced by Mr. J. R. Sully, general manager of the Stafford Works. The foremen's

Sir George Nelson presenting the foremen's shield to John C. Robinson at the Borough Hall, Stafford

shield was won for the second year in succession by John C. Robinson, and the winner of the Stafford shield was Leslie J. Minty. Highest awards were made this year to two technician apprentices, David Collier and Keith E. Owen.

In reporting on the achievements of the education department over the past year, Mr. E. G. Carwardine, education superintendent, referred to the company's various educational and training schemes.

Mr. J. N. Toothill, C.B.E., general manager of Ferranti, Ltd., Edinburgh, is the chairman of a committee appointed by the Scottish Council (Development and Industry) "to examine the position and prospects of the Scottish economy and the factors which influence the growth and location of manufacturing and other employment."

Mr. A. B. Clarke, A.S.M.A., M.S.I.T., has been appointed sales manager of Cossor Instruments, Ltd. He was previously instrumentation sales manager of J. Langham Thompson, Ltd., having joined the commercial field from the General Electric Co., Ltd., where he conducted instrumentation and flight trials with the applied electronics laboratories.

Mr. J. G. Cooper has now taken over as sales manager of H. Frost & Co., Ltd., and is responsible for home and export sales.

The latest production of the **Portland Players** (Central Electricity Headquarters Sports and Social Club) is "Bonaventure," by Charlotte Hastings, which was given on 9th and 10th November at King George's Hall, London. The action of the play takes place in a convent near Norwich and revolves around Sister Mary Bonaventure and Sarat Carn (wrongly found guilty of murder), who, with a police officer and a wardress, has sought refuge in the convent from floods. Sister Bonaventure's faith in Sarat's innocence and her unmasking of the real murderer form the basis of the plot. In the part of Sister Bonaventure, Jane Turner looked and played the part with feeling, and Dagmar Weate, as Sarat Carn, successfully conveyed the taut state of mind of one condemned to death. They were ably supported by a cast which combined to make the production go with a swing. We particularly liked Jean Crosley as the Mother Superior, and, in the small but eloquent part of Martha Pentridge (the charlady in the convent), Renee Futcher.

Mr. W. Hill has been appointed to succeed the late Mr. J. C. Laing as Derby branch manager of the St. Helens Cable & Rubber Co., Ltd. Mr. Hill will continue to be responsible for the Stoke depot, of which he has been manager for several years.

Mr. L. Clarke, M.I.Mech.E., founder and, for twenty-five years, managing director of L. Clarke & Co., Ltd., engineers, Southall, Middx., has retired as chairman of the company at his own request and will no longer act as consultant. He retains his seat on the board.

Mr. W. Millar, A.M.I.Ex., has been appointed assistant general sales manager to Mr. G. D. Mason (Industrial Division of the Simplex Electric Co., Ltd.). Mr. Millar served an electrical engineering apprenticeship on Clydeside. During the war he was in the R.A.F. and is now a lieutenant (T.A.) in the R.E.M.E. Before joining Simplex he had held positions with the Rheostatic Co., Ltd., the Uganda Co. (Africa), Ltd., the Sterling Cable Co., Ltd., and the Mersey Cable Works, Ltd. Mr. Millar will be based in London at the Alperton branch.

Mr. W. Millar

Mr. K. Lowy, formerly manager of the Champion Electric Corporation, Newhaven, has joined the board of Denham & Morley, Ltd., as sales director. The company distributes Scharpf washing machines and spin dryers from West Germany.

Eleven employees of **Brook Motors, Ltd.,** were presented with gifts for twenty-five years' service at the annual Brook "25" Club dinner on 10th November. This brings the total membership of the Club to 120 people. The chairman at the dinner was Mr. W. Brian, and the gifts were presented jointly by Mr. Frank V. Brook, chairman and joint managing director, and Mr. John L. Brook, vice-chairman and joint managing director. Mr. N. C. W. Pewtress, manager of the Swansea sales office, proposed a vote of thanks to the directors, and this was seconded by Mr. G. Bennington.

For the third year the **Telecommunication Engineering and Manufacturing Association** has held a competition for the best final year apprentice of its member-firms in three categories. Awards to the value of £25 have been granted to:—Mr. P. J. Langlois (graduate in training, Standard Telephones & Cables, Ltd.); Mr. P. N. T. Wells (student apprentice, General Electric Co., Ltd.); and Mr. J. R. Bryden (technician apprentice, Ericsson Telephones, Ltd.). These prizes will be presented to the winners at the T.E.M.A. annual dinner on 17th February next by the chairman, Mr. R. E. Robinson.

Applications for the appointment of a deputy commercial and development adviser to the **Electricity Council** are invited in our advertisement pages today. The salary offered is within the scale £3,600-£4,000 per annum.

A record number of students, together with their parents and friends, attended the seventeenth conversazione of the Henley Education Scheme, organised by **W. T. Henley's Telegraph Works Co., Ltd.** This event, at which prizes are awarded to successful students, was held at the Woolwich Polytechnic, on 14th November. Sir Alexander Sim, chairman of Henley's, received the students and guests, among whom were governors of Woolwich Polytechnic, principals of many of the technical

At the opening of the experimental electronic telephone exchange, Dollis Hill (see page 705). Left to right: Sir Thomas Eades (chairman, Automatic Telephone & Electric Co.); Sir Lionel Harris (Engineer-in-Chief, G.P.O.); Mr. J. R. Bevins (Postmaster General); Dr. J. N. Aldington (Group managing director, Siemens Edison Swan); Mr. F. C. Wright (managing director, Standard Telephones & Cables); and Mr. R. Robinson (director in charge of the G.E.C. telephone, radio and television works)

Dr. J. N. Aldington, Mr. S. E. Goodall and Dr. P. Dunsheath examine one of the handicraft exhibits at Henley's conversazione

schools and colleges attended by Henley students, and representatives of industrial concerns, including several from the Associated Electrical Industries group, of which Henley's is now a member.

Dr. P. Dunsheath, C.B.E., director of Henley's and chairman of the Henley Education Committee, presided over the prizegiving, and outlined the facilities available to students in the Henley scheme and the opportunities which were offered. The large number of students who had gained awards this year was very gratifying to the sponsors of the scheme, he said. Then followed the presentation of prizes by Sir Alexander Sim to successful students and awards for handicraft exhibits. The guest speaker was Dr. J. N. Aldington, director of Henley's and managing director of Siemens Edison Swan, Ltd. Patrick J. Howell, who has just completed his apprenticeship, replied on behalf of the students.

After a break for tea, a programme of three films was presented, including the first public showing of a new film entitled "Cable Laying Journey." The exhibition, which always forms part of this function, was based on the theme "Living with Electricity," and told the story of how electricity is produced and distributed from power stations. All the exhibits were provided by the A.E.I. group of companies. The display of students' handicrafts alongside the exhibition also attracted considerable attention.

The **Electrical Trades' Commercial Travellers' Association** is holding its annual stag party, dinner and smoker, at the Windsor Castle, Victoria Station, London, on 4th December (6.30 p.m. for 7 p.m.). Applications for tickets (18s each) should be made to Mr. F. J. E. Simons, 42, Lower Barn Road, Purley, Surrey.

The North Western Branch of the E.T.C.T.A. held its annual general meeting on 9th November at the Sefton Hotel, Manchester. The retiring chairman, Mr. G. P. Humphry, welcomed the members, following which Mr. F. Foulkes, the newly elected chairman, called for greater support from members at meetings and functions and presented the past-chairman's jewel to Mr. G. P. Humphry. Mr. J. H. Bowen, hon. general secretary, spoke of the efforts of the Branch for charity and the good work done by the retiring chairman. He also paid tribute to Mr. R. H. Corlett, the founder chairman of the Branch, who is the national chairman elect. The following officers were elected, Messrs. F. Foulkes (chairman), H. Chadwick (vice-chairman), F. A. Sullivan (secretary), W. Smith (treasurer) and C. J. S. Roberts (charity steward).

Mr. J. J. Bonaker has been appointed assistant manager, export, of the A.E.I. Lamp & Lighting Co., Ltd., with his office at Melton Road, Leicester. Before the integration of the Lamp and Lighting Departments, Mr. Bonaker was head of the Lighting Export Department, a post he had held since 1956. He joined the B.T.H. Co. in 1945 as a lighting engineer.

Mr. J. J. Bonaker

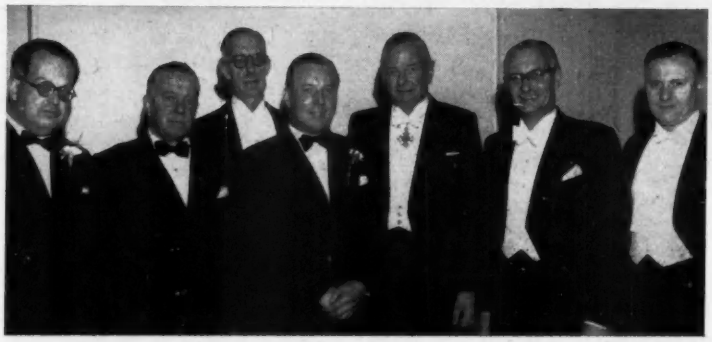
Miss Joyce J. Peck has been appointed to the English Electric Co.'s home economist team as its specialist on home laundry equipment. Miss Peck has been a domestic science teacher here and in Canada and also had three years' experience as demonstrator with the South Eastern Electricity Board.

The following appointments are announced by Tricity Cookers, Ltd.:— **Mr. H. Jaggers** becomes chief engineer and **Mr. K. E. Chad,** chief designer. **Mr. R. E. Lacey** has been appointed area manager, South Wales and Midlands Electricity Boards area, **Mr. J. A. Wheeler** becomes area manager, Merseyside and North Wales and North Western Electricity Boards area, and **Mr. B. Coffee** is appointed area manager, South Western and Southern Electricity Boards area. **Mr. J. R. Green,** who recently joined the company, is area manager, Eastern and South Eastern Electricity Boards area. He was previously eastern area manager with the English Electric Co. (Domestic Appliance Division). **Mr. D. G. Eager** has been appointed representative in Nos. 1 and 3 Sub-Areas of the Southern Electricity Board and the Mid-Sussex Area of the South Eastern Electricity Board. He was previously with the South Eastern Electricity Board at Hove. **Mr. G. Allsop,** previously with Santon, Ltd., has been appointed representative for the Merseyside and North Wales Electricity Board area, and **Mr. J. M. Brock** has been appointed representative for the South of Scotland Electricity Board area.

Dr. A. Rees Jones has been appointed a member of the parent board of Parkinson Cowan, Ltd. He remains director and general manager of Parkinson Cowan Appliances, Ltd., a division of the group.

Mr. J. A. Howie, chairman of the British Refrigeration Association and managing director of the Lightfoot Refrigeration Co., Ltd., recently left for a three-week visit to India. The Indian demand for refrigeration and air conditioning equipment is very large but the Indian Government

The annual dinner and reunion of the I.E.E. Tees-side Sub-Centre was held at the Zetland Hotel, Saltburn-by-Sea, on Friday last. Left to right: Mr. D. W. Pattenden (Sub-Centre secretary); Mr. B. G. Fairburn (chairman, Darlington Chemicals, Ltd.); Mr. H. Watson-Jones (chairman, North Eastern Centre); Mr. M. A. Raisbeck (Sub-Centre chairman); Mr. O. W. Humphreys (vice-president, I.E.E.); Mr. A. M. F. Palmer (Electrical Power Engineers' Association); and Mr. R. Bruce (secretary, North Eastern Centre)



requires it to be met by local manufacture. Mr. Howie hopes to make arrangements with Indian enterprises whereby the part always played by the British refrigeration industry in India would be maintained.

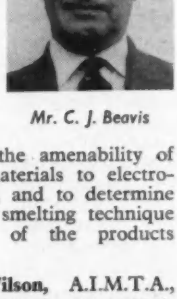
Mr. D. Barber, M.S.M.A., has been appointed sales manager of the "Sofono" Electrical Division recently announced by Federated Foundries, Ltd., to market its new range of domestic electrical appliances. He will operate from the London headquarters at 4, Stratford Place, London, W.1. Mr. Barber was formerly sales manager of H. Frost & Co., Ltd., Walsall.

Mr. D. Barber

At a ceremony at the offices of the Midlands Project Group of the C.E.G.B. at Meadow Lane, Nottingham, on 10th November, a presentation was made to **Mr. F. Favell,** Wh.Ex., M.I.E.E., M.I.Mech.E., on his retirement after 40 years' service in the electricity supply industry. The presentation, which consisted of an electric mixing machine and an automatic tea maker, was made by Mr. R. R. Maddock, chief project engineer, Midlands Project Group, who recalled that Mr. Favell was educated at Lincoln Technical College and Manchester College of Technology. After serving with the Battersea and Stoke-on-Trent Electricity Departments he joined the newly constituted North-West Midlands Joint Electricity Authority in 1930 as a generation engineer and three years later was appointed chief engineer and manager. With the reorganisation of the supply industry in 1948, Mr. Favell was appointed chief generation engineer (construction) in the East Midlands Division of the then British Electricity Authority, which position he held until the formation of the Project Groups in 1958, when he became associated with the Midlands Project Group until his retirement on 31st August last. Tributes were paid to Mr. Favell by Mr. O. S. Woods, controller, East Midlands Division, and by Mr. C. E. H. Verity, former deputy chief engineer (construction) of the Central Electricity Authority, and now a director of Foster Wheeler, Ltd.

Mr. R. R. Maddock making a presentation to Mr. F. Favell on his retirement from the Midlands Project Group of the C.E.G.B.

Mr. C. J. Beavis has been appointed by Birlec-Efco (Melting), Ltd., to take charge of all smelting activities. He was formerly works engineer for the Distillers Co., Ltd., at Port Talbot. A pilot plant is being commissioned at Aldridge to operate a contract service for electric smelting. The plant is intended to test the amenability of customers' raw materials to electro-thermal reduction, and to determine the most suitable smelting technique and the nature of the products obtained.



Mr. C. J. Beavis

Mr. J. H. Wilson, A.I.M.T.A., A.C.W.A., at present accountant-secretary of the Worcester and District Sub-Area of the Midlands Electricity Board, has been appointed as the Board's deputy chief accountant, filling the vacancy created by the recent appointment of **Mr. R. Cook,** B.A.(Admin.), A.S.A.A., A.I.M.T.A., as chief accountant. Mr. Wilson's appointment takes effect on 1st December. **Mr. R. M. Steward,** A.C.A., accountant-secretary of the North Staffordshire Sub-Area, has been appointed accountant-secretary of the Worcester and District Sub-Area, and he will be succeeded at the N. Staffs. Sub-Area headquarters by **Mr. W. C. M. Hughes,** A.C.A., at present accountant-secretary of the Central Gloucestershire Sub-Area. These appointments take effect on 1st January next.

OBITUARY

Mr. O. Ellefsen.—The death occurred at Hest Bank, nr. Lancaster, on 14th November of Mr. Ole Ellefsen, A.M.I.E.E. He was seventy-three.

Mr. A. G. Allen, manager of the eastern area of the Electrical Division of Radiation, Ltd., died on 12th November at the age of fifty-three. Mr. Allen joined the Jackson Electric Stove Co., Ltd., as a representative in the south-eastern area, subsequently becoming representative in the eastern area, and manager of the eastern area of the Electrical Division of Radiation, Ltd., in April this year. Before joining the Jackson Electric Stove Co. he was representative for the Elexcel Co., Ltd.

Professor C. T. R. Wilson, C.H., F.R.S., Nobel Laureate, Emeritus Professor of Natural Philosophy at Cambridge University, died on 15th November at the age of ninety. Professor Wilson was best known for his invention of the cloud chamber, in which the tracks of atoms or of sub-atomic particles appear as thread-like trails of tiny water drops.

WILLS

Sir Ronald W. Matthews, D.L., J.P., deputy chairman of the Independent Television Authority and former director of the Brush Electrical Engineering Co., Ltd., and other companies, who died on 1st July last, left £54,407 gross (£6,947 net).

Mr. F. Nock, chief accountant of the Midlands Electricity Board, who died on 29th July last, left £21,269 gross (£20,604 net).

Gas-Cooled Reactors

The United States Atomic Energy Commission and the United Kingdom Atomic Energy Authority have signed a five-year agreement to exchange technical information on advanced gas-cooled reactors. The exchange, effective from 16th November, will be carried out under the terms of the 1955 U.S.-U.K. agreement for co-operation in the civil uses of atomic energy.

Data will be exchanged on development, design, construction and operation, as well as on related research and development, of the advanced gas-cooled reactors being built at Windscale, England, and on the U.S. experimental reactor project of this type at the Oak Ridge (Tennessee) national laboratory. Information exchanged under this agreement will be made available to British and American industry.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM ingots	ton £180 0s 0d
COPPER, H.C. Electro	ton £254 0s 0d
Fire Refined 99·70%	ton £253 0s 0d
Fire Refined 99·50%	ton £252 0s 0d
COPPER Tubes ..	lb 2s 5½d
Sheet	ton £287 10s 0d
H.C. wire and strip ..	ton £309 15s 0d
LEAD, English ..	ton £71 15s 0d
Foreign	ton £70 0s 0d
MERCURY	flask £72 0s 0d
TIN, block (English) ..	ton £796 0s 0d
ZINC, G.O.B. Foreign	ton £95 5s 0d
BRASS Tubes (solid drawn)	lb 2s 0⅞d
Wire	lb 2s 10½d
PHOSPHOR BRONZE Wire	lb 4s 3½d
PLATINUM ..	oz £28 10s 0d
RUBBER, No. 1 R.S.S. spot	lb 38½d—38¾d

INDUSTRY AND THE HOUSE

Dealing With Threatened Unemployment

By AUSTEN ALBU, M.P., B.Sc., A.M.I.Mech.E., M.I.P.E.

FEARS for the employment of their constituents, in spite of the low general level of unemployment, remain one of the main interests of Members of Parliament. It is not surprising, therefore, that the two-day second reading debate on the Local Employment Bill resolved itself into a series of constituency pleas, particularly from maiden speakers. This Bill takes the place of all previous measures intended to deal with the problems arising in particular localities from industrial change and gives the Government new powers to deal with a developing situation, even before a high and persistent rate of unemployment exists. It will also enable grants to be made to manufacturers who wish to build their own factories in scheduled areas. The President of the Board of Trade ran into trouble with the Opposition because he refused to disclose in advance the areas which would be covered by the Bill. He did, however, indicate that it would cover rather less than the previous Acts: in fact, about 14 per cent of the population.

Drift from Older Industrial Areas

The main criticism of the Opposition, voiced by Mr. James Griffiths, was that the Bill, unlike the 1945 Distribution of Industry Act, was not designed to secure a balanced distribution of industry throughout the country. He pointed out that while the insured population increased between 1951 and 1957 by just over a million, half of this increase had been in the London, South-Eastern and Southern Regions. The older industrial areas were continuing to lose population to the newer ones at a rapid rate. Much of this loss consisted of young people, which made the task of attracting new industries to the older areas more difficult.

Mr. John Rodgers, the Parliamentary Secretary to the Board of Trade, replying to the debate, claimed that the new list of areas would cover about the same proportion of the country as was covered, in practice, at present. He also claimed that the Government's record in using Industrial Development Certificates to direct industry to the Development Areas compared favourably with what was done in the later years of the Labour Government.

While it remains true that the genuineness of the Government's belief in a planned development of the location of new industry can be judged only by its performance, an impartial observer might well wonder at the extent to which it has accepted some of the ideas of the Labour Party. Certainly to that Whiggish figure, Lord Hinchingbrooke, the Bill was an undesirable extension of the Welfare State, but in this case to businesses in distress.

The truth is that many Government supporters are beginning to realise the increasing dilemma into which the problems of rapid change in the country's economy are forcing them. In his opening speech on the Bill the President of the Board of Trade again referred to the growing rate of economic and tactical change and, in a speech in the country, he has again warned the nation that its exports are concentrated on too narrow a range of products. Mr. Fred Lee, speaking for the Opposition, reminded the House that the older industries such as cotton, coal, shipbuilding and railways, on which Britain had depended for a century, were now contracting. They should not be replaced by unskilled industries, such as "doll's eye factories," but by industries applying new scientific discoveries.

The dilemma which faces the Government was illustrated by the questions addressed to the Minister of Science by your contributor and other Labour members on the now much publicised D.S.I.R. report on the machine tool industry and on the textile machinery industry. It is not only on the Opposition side that anxiety is felt about the inadequacies of these industries and the Government is under some pressure to stimulate them into greater use of scientific resources. The Government is at present engaged in discussing the machine tool industry with both sides of industry and the Minister's spokesman in the Commons promised to bring to the attention of the D.S.I.R. the suggestion that the textile machinery industry might be an early subject for the studies which the Council is making of the research and development needs of those industries which appear not to be attracting a sufficient share of the nation's resources for technological development.

Views on Nationalisation

Even on nationalisation, on the discussion of the merits and popularity of which Labour members are spending a good deal of their time, attitudes in the House bear little resemblance to those on the hustings and hoardings. On both sides back-bench members are demanding the right to ask questions of Ministers on matters of day-to-day administration of the nationalised industries. In the now usually benevolent debate on the Post Office Bill, bouquets were cast from both sides on the efficiency and progressiveness of the Post Office and the new P.M.G., Mr. Reginald Bevins, said: "Whatever the merits or otherwise of nationalisation . . . the truth is that the Post Office is firmly established as one of our oldest nationalised services."

The Parliamentary Secretary to the Board of Trade, in answering questions about the "Hovercraft," had to admit that it was a very good example of public support by a publicly-owned company of a research and development project. It would not be surprising if Britain's economic needs rendered obsolete some established prejudices as well as some of its traditional industries.

Laboratory pH Meters

THE British Standard specifying performance requirements for laboratory potentiometric pH meters, B.S. 3145 : 1959, follows the issue in recent years of standards for pH scale and for glass electrodes (B.S. 1647 and 2586) and will in due course be complemented by a specification for deflection pH meters. Scale calibration, sensitivity, stability and input current are among the requirements dealt with in the eight-page publication, which also covers the temperature compensating device, auxiliary pH control, connection to the glass electrode and screening. Meters which purport to comply with the requirements of this specification are required to be marked with its number. Copies (price 3s) may be obtained from the B.S.I., 2, Park Street, W.1.

INSTALLATION INSPECTION

Annual Meeting of the N.I.C.

MR. C. T. MELLING (Electricity Council) presided at the annual meeting of the National Inspection Council for Electrical Installation Contracting, of which he is chairman, at the Connaught Rooms, London, last Friday.

The third annual report which he presented, covering the twelve months ended 31st March last, recorded continued progress and an increasing awareness of the Council and its work among, particularly, local authorities, consultants, architects and builders. Meetings of a variety of organisations have been addressed by the Council's officers and the number of requests for speakers is increasing.

During the year 225 applications for enrolment were received (against 252 in 1957-58); 245 applications were approved (against 136); and 33 (against 10) were rejected. The number of inspections carried out fell from 3,783 to 3,711; in these over 9,000 installations were involved. At the close of the period the number on the Roll of Approved Electrical Contractors was 5,250, an increase of 159 during the year. Preparations for the publication of the third edition of the Roll were made; 17,500 copies were ordered, mainly for free distribution. (The new edition was issued in May last.)

A further organisation, the National Union of Townswomen's Guilds, was accepted as a constituent body entitled to nominate a member of the N.I.C.

The year's expenditure was estimated at £53,000 and actually £51,228 was spent. Mr. C. T. Melling was elected chairman for 1959-60 in succession to Mr. A. F. Plummer (Electrical Contractors' Association) and Mr. S. E. Goodall (Institution of Electrical Engineers) was elected deputy chairman.

At the meeting a special resolution amending the articles of association was adopted. The main purpose was to empower the Board to co-opt any persons (ordinarily not exceeding two) to membership of the Board and to appoint alternates to members of the Board.

Informal Discussion

After the meeting there was an informal discussion. Opening this, Mr. Melling emphasised that the Council was a non-profit-making body solely concerned with the excellence of installations and not with any commercial aspect. Although the electricity supply industry provided by far the largest part of the funds, there was no partiality; the fee was small and contractors of all sizes were admitted to the Roll, provided that their work was satisfactory. The Council sought the goodwill of the public and local authorities. They saw that standards were maintained consistently; very few contractors had had to be struck off the Roll.

In the course of the discussion it was brought out that there had been an increase in the number of contractors on the Roll although some members of the E.C.A. had withdrawn because they were not actually carrying out installation work. Mr. Forbes Jackson, replying to a suggestion that the number of inspections ought to be increasing at a faster rate, said that he and his colleagues had been through some 20,000 inspectors' reports. It was interesting to see how the standard of work was improving and the increasing awareness of what the I.E.E. Regulations were. Most contractors were willing to learn and put in good installations. In time it might be possible to employ more inspectors and conduct more inspections.

Replying to another question, Mr. Melling said that it was not possible to say what proportion of eligible contractors were on the Roll. Not less than 90 per cent of the work put out to tender went to approved contractors; this was largely local authority work. Mr. Forbes Jackson said that most inspections were of the smaller kind of installations—by smaller contractors than those employed by local authorities. Mr. A. O. Johnson thought that the Electricity Boards could help by providing lists of contractors operating in their areas; then those who were not on the Roll could be approached by the Council.

Luncheon Address

Mr. Melling presided at a subsequent luncheon when Sir John Pickles gave a short address. Sir John referred to the remarkable advance in electricity consumption which, he said, meant an immense amount of new installation work, apart from the extension and replacement of existing installations. They wanted these installations to be adequate and expandable, but above all to be safe. The number of electrical accidents was very small, but they were for the most part caused by "Do it yourself" activities. The rule for electrical installation work should be "Don't do it yourself." Briefly reviewing the history of the Council, Sir John said that success would ultimately depend on persuading all reputable contractors to become enrolled and making those responsible for placing installation contracts aware of the advantage of employing approved contractors.

He concluded by referring at some length to the Building (Scotland) Act, 1959, which empowered the Secretary of State for Scotland to prescribe standards for building work, including electrical installations.

In thanking Sir John Pickles, Mr. Melling said that the National Inspection Council would not be satisfied until all electrical installation contracting was done by approved contractors. They would maintain very strict inspection and strive to attain the confidence of all concerned in this important work.

Fixed Carbon Resistors

THE first part of the British Standard for fixed carbon resistors for use in telecommunication and allied electronic equipment, B.S. 2112, applies to resistors having a dissipation not exceeding 3 W at 70°C and a rated resistance value of not less than 10 Ω and not greater than 10 MΩ. The resistors to which this standard applies are intended for use over the ambient temperature range −40°C to +100°C in one of the humidity classes (H1, H2, H3 or H3A) of B.S. 2011, "Basic climatic and durability tests for components for use in radio and allied electronic equipment."

The new publication specifies general requirements and tests. Part 2, which is to follow, will give a list of standard sizes, ratings, etc., of resistors. The standard colour code for the indication of resistance value, tolerance and, in certain instances, the grade of resistor, is described in an Appendix to Part 1. Copies may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 10s.

Harwell Neutron Project

ELECTRON LINEAR ACCELERATOR AND TIME-OF-FLIGHT SPECTROMETER LABORATORY COMMISSIONED

A NEW laboratory for basic research into nuclear structure came into operation on 5th November at the Atomic Energy Research Establishment, Harwell. The laboratory, which is under the supervision of the Nuclear Physics Division of the Establishment, extends over a 20-acre field and houses the most extensive range of neutron time-of-flight spectrometers in the world.

The neutron project laboratory is based on an electron linear accelerator which generates an intense pulsed beam of electrons. This beam falls upon a mercury target to produce X-rays, which in turn are directed upon a uranium target to produce neutrons. In this machine, the uranium target is itself a sub-critical fast reactor. The neutrons produced in this reactor are allowed to travel down a number of evacuated flight tubes radiating out from the neutron source. The equipment is intended to provide information about the detailed behaviour of neutrons of known velocities when they encounter materials employed in the construction of reactors. It will enable neutron cross-section measurements to be made with higher accuracy than previously.

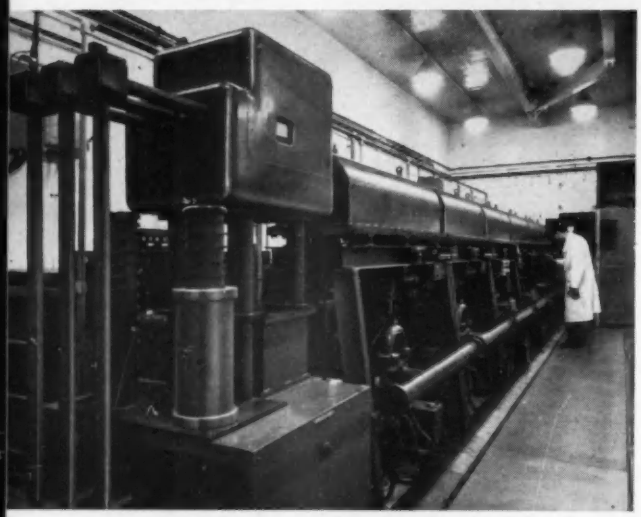
It is most important to be able to predict the rate at which various reactions will proceed inside a reactor. As most of the nuclear processes occurring in a reactor involve neutrons, it is necessary to know how neutrons of various energy spectra interact with the atoms which make up the core of the reactor. It is also necessary to be able to determine accurately the spectrum of particular neutrons.

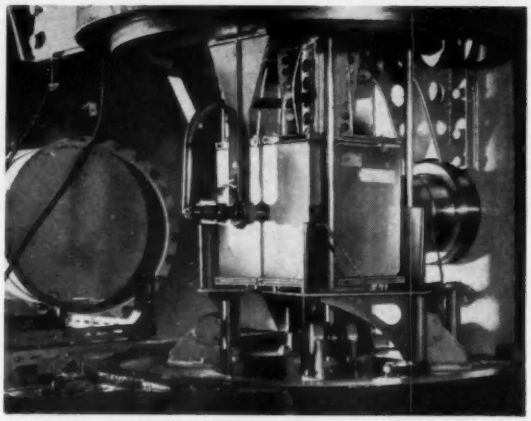
One of the difficulties of measurements with neutrons is that accurate monoenergetic sources are not easily available below 50 keV. (This is an energy region of particular interest to the reactor designer.) Also, as the neutron has no charge, it is not possible to separate neutrons from a mixed source by means of a magnetic spectrometer. A different method has therefore to be used, and one of the most successful is the time-of-flight method. In this method, a pulsed source of neutrons is used and the neutrons are allowed to pass down a long evacuated flight tube to meet a detector placed at its end. Neutrons of all energies start along this tube at the instant of the pulse, but due to differing velocities they arrive at the detector at different times. By using an electronic timing mechanism to record not only the behaviour of a neutron on arrival but also its time of arrival, it is possible to calculate which velocity, and hence energy, of neutron produces the effects observed. To obtain accurate measurements of velocity, a very short pulse of neutrons is required, and they should be allowed to travel over as long a flight path as possible. However, the length of flight path means that an extremely powerful pulsed source of neutrons is required.

Above : General view of the Harwell neutron project consisting of an electron linear accelerator and a multiplying target assembly for use in neutron time-of-flight experiments

Linear Accelerator

The pulsed neutron source is obtained with a travelling wave linear electron accelerator installed by the Metropolitan-Vickers Electrical Co. This provides an instantaneous electron beam current of $\frac{1}{2}$ A at an energy of 30 MeV. These bursts are normally $\frac{1}{4}$ microsec in duration and occur at the rate of up to 750 pulses per sec. The electron beam is allowed to fall on a mercury target serving the dual purpose of producing X-rays and removing the heat caused by stopping the beam. The X-rays are then directed into the sub-critical reactor target or booster, which was designed and built at the A.E.R.E. and uses highly enriched uranium as fuel. During the pulse, the X-rays are absorbed in the uranium to produce neutrons by photo-disintegration and by photo-fission. A factor of ten increase in neutron output has been obtained by making the uranium into a sub-critical assembly. Care has been taken in design-





Above : Neutron booster or sub-critical reactor with lead shield open

Left : Metropolitan-Vickers electron linear accelerator

ing this booster assembly in order to prevent the pulse being lengthened by the multiplication process, as otherwise the energy resolution of the instrument would be reduced.

During the pulse, the fissile assembly reacts at about 8 MW power. At the end of the pulse, the reactor reverts to its quiescent state, so that the mean nuclear power output is about 2½ kW. Hence the reactor is very small in size compared to a conventional 8 MW reactor and it is possible for the beam tubes to look at its whole surface. In the case of the usual reactor-plus-chopper combination, only a small portion of the reactor is effective as a source, with consequent loss in beam intensity.

The accelerator and neutron-producing targets are housed in a specially designed building intended to permit many experiments to be carried out simultaneously. The targets are contained within cells whose concrete walls are 6ft thick and subsidiary shielding walls 4ft thick have also been erected. The flight tubes radiate out from the neutron source and range in length up to 200 metres. Plans are being made to build a 300 metre flight tube. At the moment of the pulse an electronic stop watch is started and at the end of the tube a detector transmits a signal when the neutrons arrive and so enables their velocities to be determined. The speed of the neutrons in which interest is centred lies between 500 metres/sec and 5 million metres/sec. Already twelve experiments have been laid out in the area surrounding the building and scientists from the Commonwealth and from the United States have joined the teams assembled to use the equipment.

WAVEGUIDE MODES

IN a paper presented before the Electronics and Communications Section of the Institution of Electrical Engineers on 2nd November, Dr. A. E. Karbowiak (Standard Telecommunication Laboratories, Ltd.) commented on the waveguides now in use. In this he reserved the term " proper mode " for a certain mathematical concept and the term " quasi-mode " for a field configuration which could be supported by a physically realisable guiding structure. By viewing the radiation field, which must always accompany a guiding wave, in a somewhat novel light, the author built a bridge between modes in closed waveguides and in open structures. He demonstrated that all quasi-modes had physical reality and practical applications.

A supporting contribution by Mr. L. Lewin showed that with wavelengths of less than about 1 cm rectangular waveguide methods of transmission and component design became impracticable owing to the very small dimensions involved and increasing attenuation. To exploit the lower end of the microwave region, a transmission medium must be devised having low loss and adequate dimensions, which would call for a technique intermediate between the current waveguide and orthodox optical methods. Of six categories of transmission evaluated the over-moded square or circular waveguide, operated in the dominant mode, was to be preferred. Suggestions were made for a number of components in this medium. Means of accurately measuring and controlling spurious modes had yet to be developed.

The Development of Eurovision

WHEN he delivered his inaugural address as chairman of the Electronics and Communications Section of the Institution of Electrical Engineers in London recently, Mr. M. J. L. Pulling described in some detail the development of Eurovision. The rapid development of these exchanges of live television programmes between European countries has presented the communications engineer with some interesting technical problems, but perhaps even more important has been the challenge to his ability to improvise and to co-operate on the international plane. Ten years ago no communication engineer could have accurately forecast the technical improvements which enable us to share television programmes over the length and breadth of Western Europe today. Ten years from now we shall no doubt be taking for granted a world-wide interchange by means which at present are largely unknown.

ELECTRONIC TELEPHONE EXCHANGES

INCREASING demands on telecommunication systems and the complex nature of switching equipment have encouraged research workers to look to electronics for solutions of their problems. The use of electronics in GRACE (the equipment used in connection with subscriber trunk dialling, which was fully described in the *Electrical Review* of 12th December, 1958) and the various ways of increasing the number of simultaneous conversations over the transatlantic telephone cable have established the advantages of electronic systems. An experimental electronic telephone exchange is now undergoing exhaustive tests at the Post Office Research Station at Dollis Hill, London. When these tests have been completed, equipment for about 1,000 lines will be installed, within two years, for the public exchange at Highgate Wood, North London. This development work is the result of co-operation between the five principal manufacturers of telephone exchange switching systems and the British Post Office.

In a conventional telephone exchange, one subscriber is connected to another by metallic contacts on relays and selector mechanisms. In the electronic exchange, valves and transistors act as switching components. These elements operate either to allow currents to pass or to be obstructed and have become known as "gates." Experience in the computer field has shown that these gate circuits could open and close very rapidly: over a million times as quickly as mechanical contact selector systems.

If gate circuits are always in a condition to allow current to pass, then the electronic system is equivalent to the present mechanical system. If, however, the gate circuits are opened and closed momentarily at intervals, then a large number of conversations could be made over the common speech path by interlacing each one in the off-periods of the other. This process of interlacing speech paths in time sequence, the whole cycle being repeated fast enough for there to be no audible discontinuities, is known as time division and the equipment is called a time division multiplex system.

In the multiplex system, it is necessary to be able to select the wanted speaking circuit for each different pair of subscribers. This selection is carried out by gate circuits connected between the common multiplex and the subscribers concerned. By opening and closing the gates only for the time at which the particular speech channel is available for the subscribers concerned, each subscriber will hear only the remarks of the other. In the case of the Dollis Hill laboratory model, the multiplex cycle repeats 10,000 times per second and each speech circuit is connected for one-millionth of a second so that 100 speech circuits are available for each multiplex group. Since the telephone circuits do not operate on a 100 per cent load factor, a typical electronic telephone exchange with 100 speech circuits could be used for up to 800 subscribers.

Apart from the multiplex group apparatus, it is also necessary to include equipment to supervise the operation of the gate circuits, to register the wanted number, to translate the number being dialled into signals which operate the appropriate gate circuits and to record the cost of the call on a meter. In the Dollis Hill model, the multiplex and speech circuit equipment have been designed jointly by the Post Office and the General Electric Co., Ltd.; the supervisory equipment by Ericsson Telephones, Ltd.; the register equipment by Siemens Edison Swan, Ltd.; and the translation, metering, line information and other equipment jointly by the Automatic Telephone & Electric Co., Ltd., and Standard Telephones & Cables, Ltd.

Right: Part of a rack containing subscriber line units and associated switching equipment

Below: General view of the experimental electronic telephone exchange racks at the Post Office Research Station

INDUSTRIAL NEWS

Railway Electrification Conference

We referred last week to the British Railways Electrification Conference to be held in London next October and to the exhibition which was being arranged in connection with it. The British Electrical and Allied Manufacturers' Association, which is collaborating with the British Transport Commission in the organisation of the event, informs us that already about thirty electrical concerns have notified their intention of participating in the exhibition; the list shows that the whole industry will be well represented. The exhibition, to be held at Battersea, will consist of an outside section in which electric locomotives, etc., will be on view and about 12,000 sq ft of inside section in which manufacturers' exhibits will be housed.

British Display in Moscow

Arrangements are in hand for the organisation of a British trade fair in Moscow in June, 1961, sponsored by the Association of British Chambers of Commerce and run by Industrial & Trade Fairs, Ltd. The subject is being discussed in London with a delegation from Russia and an advisory council has been set up including a representative of the Board of Trade and a number of industrialists, among whom are Mr. G. H. Jolley, a director of Associated Electrical Industries, Ltd., Mr. W. L. Mather, chairman of Mather & Platt, Ltd., and Mr. J. B. Scott, sales director of Crompton Parkinson, Ltd.

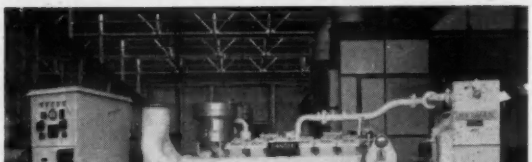
Perth Marshalling Yard

Track laying for the new marshalling yard at Perth is now almost complete. This part of the British Railways modernisation programme also includes the re-signalling of an area around Perth at present covered by 30 mechanical signalling boxes. At present, work is in progress on the installation of electro-pneumatic wagon speed retarders for the new marshalling yard. These retarders will be automatically operated from a control tower. The equipment is being supplied and installed by the Westinghouse Brake & Signal Co., Ltd.

Glass Industry Directory

The "British Glass Industry Directory and Buyers' Guide," compiled and produced for the Society of Glass Technology by Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1 (price £2, post free), in its new format, comprises four main sections, thumb indexed for quick and easy reference.

The catalogue of firms consists of names and addresses, branch offices and overseas agencies, of approximately 600 firms engaged in the glass industry with a description of their products or services. A geographical index has been included in this section with the firms' names arranged alphabetically under counties or countries. The buyers' guide contains over 13,000 names of firms alphabetically arranged under approximately 1,200 classified headings. Proprietary and trade names are listed alphabetically with a brief reference to the products to which they relate together with the name of the user. A further section is included giving addresses of and information about industrial associations, trade unions, research organisations and educational institutions, etc., connected with the glass industry.



A Paxman diesel alternator set for the Air Ministry

European Manufacturers Co-operate

The European Council of Manufacturers of Domestic Electrical Appliances decided at its recent meeting in Wiesbaden to open its membership to groups of manufacturers from all European countries. At present the Council is composed of representatives of the six Common Market countries, the United Kingdom and Switzerland. The Domestic Appliances Division of B.E.A.M.A. (representing the U.K.) thinks it likely that the invitation will be taken up when the "Outer Seven" treaty has been signed, and an important bridge will thus be formed between the six and the Outer Seven in the field of domestic electrical appliances. The B.E.A.M.A. has recently initiated discussions between manufacturers in some of the Outer Seven countries to urge the importance of wider co-operation.

Hotel Installation Contract

Simpson Bros. (of Hapton), Ltd., have been nominated sub-contractors for electrical installations for the £250,000 Keirby Hotel, Burnley, Lancs., due to open next spring. The principal contractors for the building, which was started a year ago, are the Howarth Construction Co., Ltd., Trafalgar, Burnley.

Diesel Alternators

Orders for a number of skid-mounted stand-by diesel alternator sets to a total value of more than £500,000 have been received from the Air Ministry by Ruston & Hornsby, Ltd., of Lincoln. Each set is powered by a type 12 YHX 12-cylinder diesel engine made by their associated company, Davey, Paxman & Co., Ltd., of Colchester, and the alternator has a continuous rating of 410 kW.

Disposal of Tin Stockpile

The Board of Trade gave notice on 26th June, 1959, that it intended to make available for sale the remainder of its stocks of tin amounting to about 2,500 tons. The International Tin Agreement requires six months' public notice of disposal of non-commercial stocks. The Board now announce that arrangements have been completed, subject to the formal agreement of the International Tin Council at its next meeting in December, for the sales to take place through the buffer stock manager of the Tin Council and for the tin to be available to him from 28th December next. Sales of the second 2,500 tons will be made on the same basis as that of earlier sales.

E.M.I. Sales and Service

E.M.I. announces that products hitherto handled by E.M.I. Sales & Service, Ltd., with the exception of magnetic recording materials ("Emitape") and office equipment, are now marketed by the Gramophone Co., Ltd.

In addition to its "His Master's Voice" trade mark, the Gramophone Co. will market products under the other E.M.I. marks, including "Capitol," "Columbia" and "Parlophone," and will continue to sell under the E.M.I. trade mark such equipment as professional recorders, community television installations, central aerial systems, public address, etc. The existing range of H.M.V. household appliances will be extended and new high fidelity sound equipment will be introduced by "His Master's Voice." A new board for the Gramophone Co., Ltd., has been formed. The managing director is Major J. F. E. Clarke, who is also chairman and managing director of the Clarke & Smith group of companies, of

Wallington, Surrey. E.M.I. now has an interest in the Clarke & Smith Group but Major Clarke retains control, and continues in his capacity as chairman. Other directors of the Gramophone Co., Ltd., are E.M.I. group chairman, Mr. J. F. Lockwood, and Mr. J. Wall, who is also a member of the E.M.I. group board. Mr. Wall joins the board of the Clarke & Smith Group as a director.

Contract Price Formulæ

The British Electrical and Allied Manufacturers' Association has issued the figures for its contract price adjustment formulæ. In each case the rate of pay for adult male labour at 13th November is deemed to be 196s. The "costs of materials" figures are: For electrical machinery and equipment the Board of Trade index figures published on 13th November are 179·0 (1949=100) and 115·4 (1954=100); both figures are provisional. For turbo-generating and allied plant: Materials used in mechanical engineering industries 187·5 (1949=100) and 124·8 (1954=100); both figures are provisional. Blast furnaces and iron and steel melting and rolling (40 and 41) 189·0 (1949=100) and other steel goods, excluding tubes (311 and 312), 128·8 (1954=100); both figures are provisional. The price of ¾in o/d 18 s.w.g. brass condenser tubes (*Metal Bulletin*, 13th November) is 50½d/lb.

Gresham Automation, Ltd.

The interest in the Gresham unit sequencing system, which was developed earlier this year, has been so great that a separate company, with the name of Gresham Automation, Ltd., at Gresham House, Twickenham Road, Hanworth, Middx., has been formed. The directors are Mr. J. P. Coleman, M.I.E.E. (chairman of Gresham Transformers, Ltd., and the Gresham Lion Group), and Mr. R. M. Campbell, also a director of Gresham Transformers, Ltd. Mr. D. B. Foster, Ph.D., M.I.Mech.E., M.I.E.E., M.I.Chem.E., F.Inst.F., is consultant to the board. The company has been established to advise on complete automation schemes and the supply of Gresham unit sequencing systems, together with all other ancillary instruments and controls.

Steel Company's Development

Brymbo Steel Works, Ltd., the North Wales special and alloy steel plant, announces that the board of its parent company, Guest Keen & Nettlefolds, has agreed to a second development scheme involving capital expenditure of over £2 million. In the first scheme, completed this year, the old open hearth melting shop was replaced by a new melting shop with three 45-ton electric arc furnaces, supplementing the existing three 30-ton furnaces and making the plant all-electric. At the same time the Brymbo process, based on the pre-refining of blast furnace metal with tonnage oxygen for subsequent use in electric furnaces, came into operation.

The new scheme consists of the complete replacement of the four old ingot reheating furnaces by a continuous bogie furnace, the installation of a new cogging mill, which will enable the works to take full advantage of the increased steel-making facilities and will roll ingots two and a half to three times as large as those at present being rolled. At the same time bottom pouring facilities will be introduced and the handling and cooling arrangements for the finished billets will be completely revised.

The scheme will be carried out in two stages. The new reheating furnace and the bottom pouring facilities should be in full operation by August, 1960, and the new cogging mill and billet handling facilities will be brought into operation in August, 1961. When these changes are completed production may rise to 250,000 ingot tons per annum.

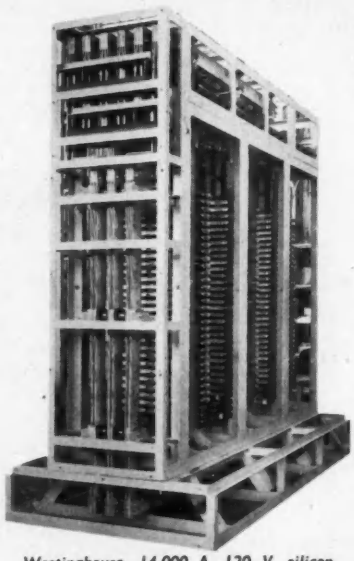
Census of Production, 1959

An order has been made by the Board of Trade covering the Census of Production to be taken in 1960 for 1959. The order, which will operate from 31st December, 1959, prescribes the matters about which returns may be required. This census will be the first of a series of simple annual censuses for the years between the detailed census for 1958 and the next detailed census.

The census of production to be taken in 1961 for 1960 will be similar to that to be taken next year except that sampling methods will be employed.

Silicon Rectifier for Chlorine Production

A large silicon rectifier equipment has been completed by the Westinghouse Brake & Signal Co., Ltd., and is being shipped to India to provide current to electrolytic cells for chlorine production. The rectifier plant is rated at 27,500 A at 60-120 V d.c. and comprises a regulator and transformer connected to the 22 kV system, a water-cooled silicon rectifier and a control cubicle with automatic adjustment of the d.c. supply to maintain a constant chlorine production rate. A floor space of only 57 sq ft is required for each of the two rectifier cubicles.



Westinghouse 14,000 A 120 V silicon rectifier cubicle

Cable Laying for Kent Coast Electrification

The *première* of a film entitled "Cable Laying Journey" was given at the A.E.I. cinema on 10th November by W. T. Henley's Telegraph Works Co., Ltd. The film deals with the laying of 88 miles of 33 kV three-core oil-filled cable for the Kent coast electrification scheme. It includes sequences showing the manufacture of the cable and various aspects of installation and jointing work. The outdoor sequences were taken near Whitstable and between Dover and Folkestone. The film, which is in 16 mm size, runs for 30 minutes and is available on loan on application to the advertising manager, W. T. Henley's Telegraph Works Co., Ltd., 51/53, Hatton Garden, London, E.C.1.

"Sofono" Electrical Division

Federated Foundries, Ltd., announces the formation of a new "Sofono" Electrical Division for the manufacture of domestic electrical appliances of the Grange-Camelon Iron Co., Ltd., a member of its group. The first group of appliances to be produced at the new factory at Falkirk is a range of electric heaters and fires. Basically, the new appliances consist of a convector heater in 1 kW and 2 kW models with optional thermostat; a combined reflector/convector heater in 1 kW and 2 kW models with optional thermostat; 1 kW and 2 kW reflector fires; and 1 kW and 2 kW fires with adjustable-angle reflectors. A wall-mounting kit for the 1 kW adjustable reflector fire is available.

Equipment for Cableship

The contract for the supply of the whole of the cable machinery and cable handling gear for the new British Post Office cableship has been placed by the builders, the Fairfield Shipbuilding & Engineering Co., Ltd., with Submarine Cables, Ltd. (owned jointly by Siemens Edison Swan, Ltd., and the Telegraph Construction & Maintenance Co., Ltd.). The design and manufacture of this equipment, which is to be completed by November next year, will be the responsibility of Telcon's Engineering Division and will be carried out at Telcon Works, Greenwich.

The two forward picking-up and paying-out cable engines, each weighing approximately 50 tons, will be of the new Telcon-Hindmarch design, so arranged that both port and starboard

gears can pick-up or pay-out over the bows, whilst the port gear can also be used for laying cable over the stern. The diameter of the cable drums is 7ft on the tread. Each cable engine will be driven by a 250 h.p. d.c. electric motor fed from a ring main and capable of being used regeneratively when cable is being paid out. Four choices of gear ratio are available in the cable engine drive, all gears being in constant mesh and engaged or released through hydraulic clutches.

The entire gear train, running in ball and roller bearings, is totally enclosed and oil-sealed and, together with the remote controlled oil-operated clutches, is the product of Modern Wheel Drive, Ltd., which has designed it to Telcon requirements.

Arc Furnace for Vacuum Casting

For melting and refining high grade carbon, alloy and stainless steels to be cast in vacuum into ingots for forging, the English Steel Corporation, Ltd., has ordered from Birlec-Efco (Melting), Ltd., a 21ft diameter arc melting furnace with a nominal charge capacity of 80 tons. The furnace, to be rated at 20 MVA, will be supplied with an A.E.I. transformer equipped with on-load tap changing equipment of the resistor bridging type arranged for remote electrical control. The electrode raising and roof-swing gear will be supported on a chassis independent of the furnace shell. An A.E.I. amplidyne system will be used for controlling the electrode movements and the electrode arms will be pneumatically counterbalanced, a development recently introduced by Birlec-Efco for large arc melting furnaces.

Batteries for Skelton Grange "B"

Three Chloride Planté lead-acid batteries and associated control gear are being supplied by Chloride Batteries, Ltd., to the C.E.G.B. Northern Project Group for the new Skelton Grange "B" power station, for which Messrs. Merz & McLellan are the consulting engineers. For emergency lighting and power supplies to the emergency lubricating and seal oil pump motors, a 240 V battery is being supplied, consisting of 115 Chloride Planté cells type OFW.10, having a capacity of 1,500 Ah at the 10-hour rate of discharge. A second battery, of 110 V, for switchgear operation, consisting of 55 Chloride Planté high performance lead acid cells type BEDG.21, will supply an emergency load of 50 A for three hours and during the last 45 seconds of that period will provide an additional current of 80 A for fifteen circuit-breaker operations, each of 3 sec duration.

With each of these two batteries mercury arc equipment will be provided, arranged for automatic trickle charging under constant voltage conditions, while maintaining a variable d.c. load. To enable the batteries to be recharged in the minimum time an automatic constant current characteristic is incorporated. Control panels for the battery and rectifier circuits and 12-circuit distribution switchboards are also being supplied.

To supply continuous and intermittent loads for communication, alarm and indicating systems, a 50 V battery with control panel and 8-circuit distribution switchboard will be supplied. The battery consists of 25 DBNG.8 Chloride cells with a capacity of 240 Ah at the 10-hour rate of discharge.

Control Gear Order

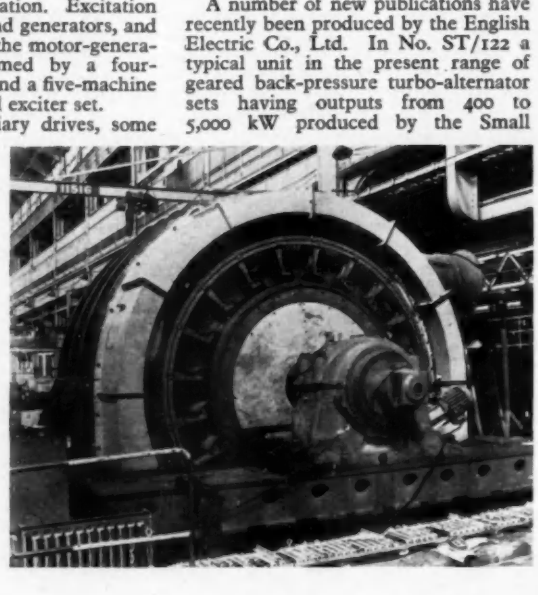
An order for electric control gear for the Northfleet power station extensions has been placed by the Central Electricity Generating Board with Brookhirst Igranic, Ltd., a Metal Industries Group company. The order is valued at £89,000 and covers in the main the supply of nine "Chester Major" switchboards, having a total of 148 swing-out units. Delivery of the equipment is scheduled to begin in October, 1961.

Equipment for Rhodesian Steelworks

A large quantity of electrical equipment for a new 38in hot reversing blooming mill at the Rhodesian Iron & Steel Co.'s Que Que works, Southern Rhodesia, has been completed by the Heavy Plant Division of Associated Electrical Industries, Ltd. The plant was manufactured at Trafford Park, Manchester.

The main drive for the mill is provided by a 5,000 h.p. d.c. motor with Ward-Leonard control and forced ventilation. A slipring induction motor rated at 4,000 h.p. 590/480 r.p.m. 11 kV three-phase 50 c/s drives the motor-generator set, which includes two 2,000 kW shunt-wound, separately-excited generators. Like the main drive, the motor-generator set has forced ventilation. Excitation of the main motor and generators, and dynamic braking of the motor-generator set, are performed by a four-machine exciter set and a five-machine amplidyne-controlled exciter set.

For various auxiliary drives, some twenty-two motors, rated at between 7½ h.p. and 250 h.p., are being supplied. D.c. supplies to the manipulator, screwdown, and breast roll drives will be provided by a nine-machine motor-generator set and two four-machine amplidyne sets.



Commutator end of the 5,000 h.p. motor being supplied by A.E.I. Heavy Plant Division for driving a new 38in hot reversing blooming mill of the Rhodesian Iron & Steel Co., Ltd.

Telephone Cables for Trucial Oman

As a result of a recent joint survey made in the State of Dubai in Trucial Oman (Persian Gulf) by International Aeradio, Ltd., and the Telegraph Construction & Maintenance Co., Ltd. (Telcon), the latter company has been awarded the contract for the cables for the installation of a complete automatic telephone system.

The township of Dubai consists of two districts—Deira and Dubai—separated by a wide creek. There is at present no telephone system in Dubai. I.A.L., as the operational and technical managing agents (as well as participants) of the embryo Dubai State Telephone Co., agreed to the provision of a completely automatic telephone system in Dubai and Deira. The presence of the creek will render a short length of submarine cable necessary. Telcon will manufacture this submarine cable and the requisite underground junction cables, underground and aerial distribution and subscribers' cables, drop wires and the usual installation material. All the cables, including the submarine portion, are to be insulated with polythene.

Linear Accelerator for Australian Hospital

A 4-million electron-volt linear accelerator for X-ray treatment of deep-seated tumours is being built in this country by Mullard Equipment, Ltd., for the Cancer Institute Board of Victoria. Valued at £60,000, it will be installed at the Board's Peter MacCallum Clinic in Melbourne in the middle of next year.

English Electric Publications

A number of new publications have recently been produced by the English Electric Co., Ltd. In No. ST/122 a typical unit in the present range of geared back-pressure turbo-alternator sets having outputs from 400 to 5,000 kW produced by the Small

Steam Turbine Department at Whetstone, near Leicester, is described. A unit type geared condensing turbine to perform marine auxiliary duties from the 350 to 1,500 kW range produced by the Marine Department at Rugby is described in booklet MR/111, and publication PS/133 produced by the Electrical Plant Sales Department at Stafford deals with squirrel-cage and slip-ring induction motors for speeds up to 1,800 r.p.m. High-torque, high-slip squirrel-cage induction motors for applications involving high inertia and frequent load changes in the 1 to 20 h.p. range are described in pamphlet DM/257 produced by the Industrial Machines Department at Bradford.

Hotelympia

The Hotel and Catering Exhibition will be held at Olympia, London, from 19th to 28th January. In addition to 250 exhibitors there will be cookery demonstrations and a "Salon Culinaire," and new techniques in frozen food, cookery methods and other services will also be demonstrated.

Batteries for Royal Mail Ships

Batteries and associated control equipment are being supplied by Nife Batteries, Redditch, Worcestershire, to provide power for emergency services in the three 20,000-ton passenger and cargo vessels, *Amazon*, *Aragon* and *Arlanza*, under construction by Harland & Wolff, Ltd., Belfast, for Royal Mail Lines, Ltd. Each vessel will be equipped with a 230 V battery of 192 heavy duty low resistance cells having a capacity of 320 Ah.

Patents Delegation to Russia

The Comptroller-General of the Patent Office, Mr. G. Grant, C.B., is leading a delegation which left for Russia yesterday (Thursday) to discuss the protection available in the U.S.S.R. for British inventions.

Engineering Insurance Company's New Headquarters

The British Engine, Boiler & Electrical Insurance Co., Ltd., has recently moved to new headquarters at Longridge House, Manchester, 4, and has issued an illustrated booklet describing the new premises.

New Winders for Silverhill Colliery

In the change-over from steam to electric winders at Nos. 1 and 2 shafts of Silverhill Colliery (East Midlands Division, No. 4 Area, N.C.B.), at Sutton-in-Ashfield, Notts., the electrical parts for the new winders have been supplied by the A.E.I. Heavy Plant Division, as main contractors, from their Trafford Park (Manchester) factory.

In No. 1 shaft a d.c. geared drum winder has been installed in a new winder house erected on the opposite side of the shaft to the original building. The winder drum, supporting two cages in balance, is of the single cylindrical type, 18ft diameter by 8ft wide, with a maximum speed of 30·25 r.p.m. Its 800 V d.c. driving motor is rated at 1,500 h.p., 300 r.p.m. and is supplied from a mercury-arc convertor, the first production equipment of this type in Britain. The mechanical parts of the winder were sub-contracted to Markham & Co., Ltd., of Chesterfield. In No. 2 shaft the steam driven winder is shortly to be replaced by a new electric winder driven by a 200 h.p. a.c. motor.

The public showroom at the new south-west regional headquarters of Philips Electrical, Ltd., Bristol

Institution of Plant Engineers

The London Branch of the Institution of Plant Engineers announces that Dr. H. A. Thomas is to give a paper on "An Introduction to Electronic Data Processing" at the Royal Institution on 3rd December. Admission will be by ticket only and applications should be made to Mr. L. R. Leworthy, chairman of the London Branch Papers Committee, Institution of Plant Engineers, 2, Grosvenor Gardens, London, S.W.1.

Henley Cables India, Ltd.

With reference to the recent announcement regarding the activities of the above company, we are informed that A.E.I. India (Private), Ltd., as well as Voltas, Ltd., will distribute cables manufactured by Henley Cables India, Ltd.

Data Processing

One of the nine full-length articles in the latest issue of the Iliffe quarterly journal *Data Processing* tells how a small organisation employing 80 people has achieved rapid, efficient handling of insurance statistics on 20 million tons of shipping, with the aid of a single accounting machine and a paper tape punch.

Other articles include "A Layman's Guide to Transistors" and "The Automatic Selection and Reproduction of Industrial Documents." *Data Processing* (Dorset House, Stamford Street, London, S.E.1) is available on subscription of £4 per annum.

Silicone News Sheet

The first issue of a four-page newsletter featuring information about the ways in which silicones are used today in all forms of industry has been produced by Midland Silicones, Ltd. It contains details of the saving in floor space at a paper factory achieved by using silicone insulated class "C" transformers and also refers to the use of silicone insulated traction motors in electric locomotives for South African Railways. Initially appearing bi-monthly, it is expected that "Silicone News" will eventually be produced monthly. Copies are available from the head office of Midland Silicones, Ltd., 68, Knightsbridge, London, S.W.1.

Price Reductions

The M.O. Valve Co., Ltd., a subsidiary of the General Electric Co., Ltd., announces price reductions for certain television cathode ray tubes, with effect from 9th November.

Trade Announcements

The headquarters of the **C. C. Wakefield & Co., Ltd.,** group are now at Castrol House, Marylebone, London, W.1, which now accommodates the staff from the several buildings previously occupied in Grosvenor Street, W.1.

British Insulated Callender's Cables, Ltd., announces that a further telephone line (Carlisle 25093) has now been connected at its Carlisle branch office.

Berry's Electric, Ltd., has appointed Mr. P. Birchley as representative for the North Midlands. He was previously with the Midlands Electricity Board. The company has also appointed Mr. J. F. Keating as its representative in the area covered by the Merseyside and North Wales Electricity Board, with which Board he served for a number of years.

Griffin & George, Ltd., Wembley, Middlesex, have opened a branch at 626, Welbeck Road, Walker, Newcastle-on-Tyne. To mark the opening an exhibition was held at Newcastle and a second exhibition is being held at the Corporation Hotel, Corporation Road, Middlesbrough, from 23rd to 25th November.

Mr. D. I. Campbell, B.Sc.(Econ.), has been appointed a lighting division representative of the south-east region of **Philips Electrical, Ltd.** He will cover parts of the S.W. and S.E. London postal districts.

New Tricity Products

RE-STYLED "Marquis" and "Viscount" cookers, a new refrigerator and a modified production model of the company's experimental "Built-in" electric cooker have been introduced by Tricity Cookers, Ltd., Thorn House, Upper St. Martins Lane, London, W.C.2.

The most striking change is in the hob design of the cookers; 7in radiant plates have now been adopted as standard—solid plates are out—and the grill is completely independent. An all-over spill tray which can be removed for cleaning without switching off the cooker is also incorporated and all the hotplates are hinged to facilitate cleaning. The use of 7in size radiant plates is claimed to provide several advantages. Each has a loading of 2 kW, which means faster heating; they are more economical than larger plates of the same loading when small saucepans are used; ground-base utensils are not essential; if the plates are used in rotation, their length of life is greatly increased; and replacement costs are lower than those for equivalent conventional radiant plates. The hotplates and switches are numbered to facilitate identification.

The independent grill extends the full width of the cooker and is fitted with a 2·2 kW tubular element. It will take six slices of toast at one time, and, like the hotplates, is simmer controlled. The two-position grill pan is designed to slide out of sight when not in use and a deflector plate on the front of the grill serves the double purpose of eliminating splashes and keeping the handle cool. A removable panel is also provided above the grill element so that fat splashes can easily be cleaned off. Both cookers have a 3,600 cu in oven, large enough to take a 36 lb bird; a full width inner glass door; and eye-level controls.

Re-styled Tricity "Viscount" (left) and "Marquis" cookers and the new "Four-point-Two" refrigerator

The three-plate "Viscount" is available in either ivory or white with an interchangeable facia panel in a choice of colours. The measurements are 50⅞in high (36in to top of hob) by 21in wide by 20⅞in deep and the total loading is 10·6 kW. The price is £43 10s plus £5 5s for auto-time control.

The four-plate "Marquis" has an internal oven light, a neatly designed hob floodlight and auto-time switch control. A 5-hour minute timer is fitted as standard and there is also a convenient storage drawer at the base of the cooker. Colours available are ivory or white, with a pink or blue control panel. The cooker measures 53in high (36in to top of hob) by 21in wide by 20⅞in deep. The total loading is 12·6 kW and the price is £63.

The "Built-in" cooker consists of two independent units, the oven and hotcupboard grill assembly and the surface unit with four hotplates and a separate switch control panel. The oven has a capacity of 3,600 cu in and measures 15½in high by 15in wide by 15½in deep. It has a side opening oven door, hinged on the left, and there is also a full-width inner glass door and an interior light. The loading is 2·4 kW. The hotcupboard incorporates a 2·2 kW grill, simmer controlled. The price of this combined unit is £55. On the hob of the surface unit are two 8in and two 6½in radiant hotplates, with simmer control housed in a separate switch unit, designed to be fitted at the front of the cabinet. The total loading is 6·7 kW and the price is £40. The finish is in white or ivory with a pink or blue facia panel.

The new Tricity refrigerator, the "Four-point-Two," is the first to be produced by the company. As its name indicates, the capacity is 4·2 cu ft. The door holds eight pints of milk, and has an enclosed butter/bacon compartment and a fold-away shelf to hold nine eggs. The unit is mounted on four rubber wheels and is fitted with a brake lever to ensure stability when in position. The freezing compartment also contains a fats tray which can be easily removed without disturbing other stores. The interior finish is of high impact "Polystyrene," and the door, when open, does not project beyond the width of the refrigerator. Other features include an interior light and a salad drawer with combined glass lid and shelf. Its "Tecumseh" compressor is driven by a $\frac{1}{10}$ h.p. motor incorporating a start and overload relay. The overall dimensions are 36in high by 21½in wide by 25⅛in deep, including handle, and the styling and finish are designed to be complementary to the new cookers. The price, including purchase tax, is £66 3s.

Gas Turbine Generators for Iraq

Associated Electrical Industries Export, Ltd., has received an order of over £400,000 in value from the Basrah Petroleum Co., Ltd. To extend its export facilities, the Basrah Petroleum Co. is building a deep-sea terminal in the Arabian Gulf 25 miles south of Fao for tankers up to 65,000 tons. This involves the provision of additional generating equipment at Fao, and the order placed with A.E.I. covers the necessary power plant, switchgear and interconnecting cables.

The power plant will consist of three gas turbine-generator sets, each of 2,250 kW nominal rating and comprising an L.21 axial-flow gas turbine driving an a.c. generator through single reduction gearing. Manufacture will be mainly at the A.E.I. Turbine-Generator Division's Trafford Park works, but some portions of it will be made at the Germiston, Glasgow, works of the division. The first generating set is due for completion in fifteen months, and the three sets will be delivered in twenty-two months.

SUBMERSIBLE PUMPING PLANT

Authors' summary of the paper by H. H. Anderson, B.Sc., A.M.I.C.E., M.I.Mech.E., and W. G. Crawford, B.Sc., A.M.I.E.E., read before a meeting of the Utilisation Section of the Institution of Electrical Engineers on 12th November

THE raising of water from below the ground has been one of man's earliest problems. A recent development over the last twenty or thirty years has been the provision of motors running wholly in water, so that they may be situated close to the pump below the standing water of the well. Such motors present problems of insulation, of corrosion and of thrust bearing design, but are found to be attractive compared with the conventional shaft-driven pump with a motor at the surface, particularly for the small quantity high head duties which favour high speed. Economics of borehole drilling naturally favour a smaller diameter unit and, by avoiding a long length of vertical shafting, advantage can be taken of two-pole motor drive for duties up to about 130 h.p.

A water-lubricated bearing has a very much less load capacity than an oil-lubricated bearing and, in consequence, a very careful investigation must be made of the thrust loadings imposed by the pump on the motor during all normal and transient operating conditions to ensure adequate thrust bearing life.

The submersible pump suffers from cable losses in the well and from the fact that the motor rotor is running in water, but in the majority of pumping applications these losses are less serious than the losses of vertical shafting and the thrust bearing to take the shaft weight. First cost is often lower with a submersible unit than with a shaft-driven unit.

On starting, the pump operates against zero head until the water is raised in the pipe column. Also, on power failure, the water column reverses, which, in consequence, reverses the rotation of the pump and overspeed is involved. A careful study must, therefore, be made of all these transient conditions to ensure that the rotational overspeed is safe, that the bearing will accept the reversed direction of rotation and that the pipeline is not subjected to dangerous cavities and, on return of pressure wave, to excessive pressures.

To prevent entry of grit and contaminated water, a carbon seal is fitted at the driving end of the motor.

Fig. 1.—Various sizes of submersible pumps

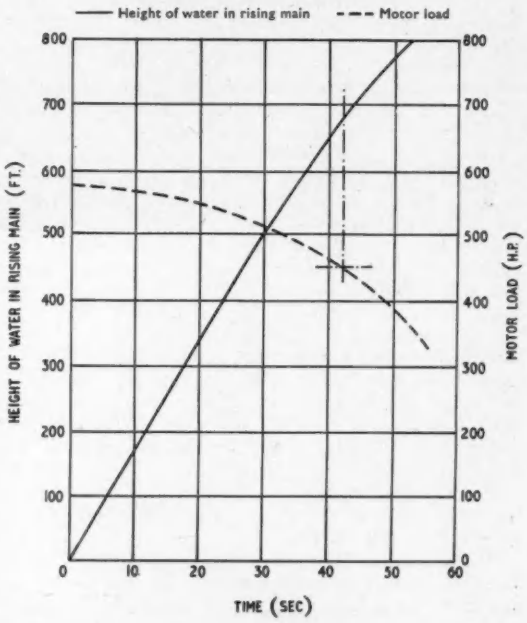
To allow for the thermal expansion and contraction of the water in the motor with change of temperature due to change of load, the motor has an expansion chamber with a special rubber diaphragm at the bottom end. In spite of these precautions, the water inside the motor is gradually contaminated by the well or mine water, so that it is necessary to take steps to control corrosion. This is essentially a matter of choosing the correct materials. The choice of materials is severely limited and cannot be readily modified to suit special conditions. There are, however, many instances of motors being in service for 50,000 hours without lifting for examination or maintenance.

Winding Insulation

The stator winding insulation must be suitable for long immersion in water. Following trials with a variety of wire coverings, it was decided a number of years ago that p.v.c.-covered wire was the best material then obtainable. Since that time, a number of new materials have become available and the possibility of using them is under consideration. Using p.v.c.-covered wire, submersible motors for voltages up to 3,300 are in normal production.

The electrical design of these motors is based on conventional induction motor theory. As the motors are very long and the shaft thin and flexible, see Fig. 1, a large "air gap" is necessary. To keep windage area

Fig. 2.—Variation in motor load and height of water column with time during filling of rising main



friction losses to the minimum, tunnel slots are used on both stator and rotor. Consequently, the magnetising current is large and the short-circuit current low, so that the power factor is considerably lower than for conventional motors. This can be readily corrected by condensers. The low starting current makes it possible to use direct-on-line starting in many cases.

As p.v.c.-covered wire must not be operated above 60°C, the motor temperature rise is limited to 40°C. Tests and theory show that the motor heating and cooling time constant is extremely short: about eight minutes for a 70 h.p. motor. Submersible motors must therefore be regarded as continuous maximum rated machines. For a temperature of 40°C, the p.v.c. insulation resistance will fall to about one-hundredth of its original value. A low insulation resistance in a hot machine must therefore be regarded as normal and satisfactory, provided that as the machine cools down, the insulation resistance rises considerably.

During the filling of the rising main, the motor may be overloaded for a short time. As the duration of this overload is short compared with the heating time constant of the motor, this does not cause overheating of the motor. Fig. 2 shows the variation in load on a 450 h.p. submersible motor during the filling of the rising main.

DISCUSSION

Mr. H. R. Lupton, who opened the discussion, said that not long ago he had needed some submersible pumps to lift surface water 13ft into a reservoir. Although low-lift pumps had important applications in land drainage and possibly harbour work, he could not get an English manufacturer of submersible pumps to quote him for the pumps he required and had had to get them from abroad. He had always been anxious to introduce some air into the motor of a submersible pump to reduce the loss of efficiency due to the viscosity of the water and some of the loss of power factor due to the present necessity to put the rotor and stator bars in tunnels. In a vertical submersible motor, air might be introduced from the surface through a tube and an escape valve for surplus air and displaced water could be provided. He regarded the information given in Fig. 17 of the paper as of first-class importance. It meant that the best efficiency obtainable for any given output could be obtained without reference to the head, provided that the pump of specific speed most suited to the duty was chosen.

Mr. G. P. E. Howard (Hayward Tyler & Co.), representing a company in the same line of business as the authors', said he found little in the paper, particularly on the pumping side, with which to quarrel, but did not agree with the carrying capacity given for bearings. His company rated their bearings at 400 lb/sq in, as compared with the authors' 100 lb/sq in, and were making a unit to run at 1,200 lb/sq in. From research, they knew that these were conservative figures. He agreed with the authors that when a motor was new the journal bearings were lightly loaded, but when the bearings wore there was an unbalanced magnetic pull which could rise to high values. Wherever possible his company started their motors direct-on-line. The starting time was so fast that there was likely to be less shock on the line than by using auto-transformers as suggested by the authors. A 350 h.p. four-pole motor took peak current for 30 cycles and was up to speed in 50.

Mr. C. A. M. Thornton (I.C.I.), whose organisation has been using submersible motors for 25 years, said they had been through a number of vicissitudes, but found today that they could put the motors down several hundred feet and leave them there for seven years. The corrosion of rotor and stator cores twenty years ago had been alarming. Present practice was to sleeve the rotor with non-magnetic steel and to keep the internal water of the motor separated from the external water so that corrosion products could not be continuously removed. In this way, motor lives of seven years before major overhaul were obtained. Normally, p.v.c. was the best stator insulation, but they had successfully used polythene. Their plastics experts told him that terylene would probably be satisfactory; it was more expensive, but might have better mechanical properties. Nylon would not be suitable for the insulation of stator windings immersed in water, but might be the best material for plastic bearings. While p.t.f.e. was suitable for plastic bearings, it was much more expensive than nylon. Designers were usually very conservative in the selection of maximum shaft size for a given rotor diameter and, for a rotor of 7in diameter, would use a 2½in diameter shaft, whereas he had successfully used one of 4in.

Mr. F. Wood (Metropolitan Water Board) said that the Board had between 50 and 60 of these units, some of the type described by the authors and others of the dry type, of which about half were in continuous use. From figures taken over about a million running hours, he found that the average life was between 17,000 and 18,000 hours. The longest record was that of a dry motor which had been running for 80,000 hours and was still at work. They found that horizontal motors were very flexible and specified that the units which they bought must be capable of running horizontally or vertically. From figures obtained in 1955, he found that for units for the same duty, 120 h.p.-hr, with a depth of well of 180ft, the price was in the ratio of 3 for a submersible pump to 4 for a spindle pump. The prices crossed over depending on the depth of well, and at 80ft the spindle pump would be cheaper. The running costs, excluding labour but including capital charges, worked out at about 2d per water-h.p.-hr for submersible pumps and for spindle pumps at about 2¼d.

Mr. D. Purvis pointed out, on the question of thrust bearing design, that at the Supply Section meeting the previous day, it had been stated that Michell bearings should be designed for a pressure of 400 lb/sq in and that pressures of 600 lb/sq in could be used.

Messrs. J. Tozer and R. A. Worster made short contributions to the discussion, to which both authors replied at considerable length. Mr. Anderson said that they would have to reconsider their bearing loadings in the light of what had been said. Their use of 100 lb/sq in dated from the time when they used large plastic pads; their present metal pads would probably take 1,000 lb/sq in. Mr. Crawford, on the other hand, said he would want to think for a long time before making any drastic change in their normal practice. He pointed out that in comparing designs, it must be kept in mind that each designer responsible for a range of machines worked out a procedure and practices which together resulted in a satisfactory product, and it was often dangerous to transfer a practice which was successful on one group of machines to another, apparently similar, group. Replying to Mr. Lupton, he pointed out that the use of air in submersible motors would involve a number of serious difficulties, for example, in connection with cooling the windings and with lubrication. Replying to Mr. Tozer, who had asked for particulars of the cable box, he said their present practice was to use a vulcanised joint between the motor cable and rising main cable.

PUMPED-STORAGE INSTALLATIONS

AT a meeting of the Supply Section of the Institution of Electrical Engineers on 11th November Mr. J. H. Walker, M.Sc., Ph.D., M.I.E.E., A.M.I.Mech.E., presented a paper on "Generator/Motor Problems in Pumped-Storage Installations." The author dealt with the electrical ratings of the generator/motor units and the possibility of using two-speed synchronous machines for this duty. Reference was also made to the problems arising in connection with starting a set on the pumping cycle, the design of the thrust bearing and the arrangement of the ventilating system in cases where the direction of rotation when pumping was opposite to that when generating. Frequent stopping being a characteristic of pumped-storage stations, the author showed that it was advisable to supplement the action of the friction brakes by a simple form of dynamic braking. An article based on the paper was published in the *Electrical Review* of 9th October.

Scottish Project

Opening the discussion, Mr. C. L. C. Allan (North of Scotland Hydro-Electric Board) said that work was just beginning on a 400 MW pumped-storage scheme at Cruachan on Loch Awe, with four 100 MW sets. The first two were to come into service in 1965 and the second two in 1966, so that generating plant would have to be ordered in the second half of 1960. Pumped-storage schemes, like hydro schemes, had the advantage of quick starting and stopping and absence of standby losses, but must show clear economic gains. The cycle obviously involved losses and the fuel cost of the energy used in pumping must be multiplied by 1½ to give the energy cost by the time the power was returned to the system. If pumping was done by a nuclear plant at a fuel cost of 0·2d/kWh the energy cost would be increased to 0·3d by the time it was returned. When pumping from coal-burning plants, this increase would limit the hours of running. Secondly, the scheme would defer the installation of alternative high-merit thermal plant. A pumped-storage scheme must therefore show a saving in fixed annual charges.

In this connection, modern developments in reversible combined pump/turbine plant were very significant. Research showed that it might be possible to develop a single-stage machine even for the high head of 1,100ft at Cruachan, thereby securing considerable capital savings on plant and space. Two-speed machines had serious drawbacks, one being that the output of the plant as a pump was larger than that when acting as a generator, which was the reverse of what was required. This might be overcome by having three reversible pump/turbines and a fourth machine which was an ordinary generator. This fourth machine would be cheaper and smaller and would ease the starting problem.

With pumping, there would be a regular succession of starting surges, probably at about the same time each day, which would be objectionable. Investigations into the 100 MW machines to which he had referred, showed that to avoid large "bumps" the starting current must be below the full-load current of the machine. Recent tests on a hydro machine of 21 MW showed that, with twice full-load current, it did not break away, but when jacked up, a current less than full-load current applied, and the jacks released, it started.

Mr. J. H. Aylward (A.E.I.) said that the design of a braking system for high inertia machines for pumped-storage and peak-load generators could be a very difficult problem. The brakes might have to operate two or three times a day and temperatures of the order of 700-800°C were reached. If speed in shutting down was not important, it seemed essential to conserve the pads by shutting down from as low a speed as possible, but where the speed of shutting down was important, as it might be on a pumped-storage scheme, some form of dynamic braking might be necessary.

Mr. C. Lyon (Messrs. Merz & McLellan) pointed out that the capital cost of a pumped-storage scheme could be similar to that of a new steam power station of about the same rating, so that a great deal turned on the differential economy of the energy which was being stored and re-used. The present trend seemed to be to use reversible machines for heads higher than the 600ft mentioned by the author, and possibly for heads considerably above 1,000ft. The fact that it was possible to build machines of very large rating did not necessarily mean that they afforded the most economic solution, because they introduced transport difficulties and put up the civil engineering costs. An associated problem was the effect which 100 MW or 200 MW blocks of load, both generating and pumping, would have on other stations in the vicinity and on the system. On the question of the size and frequency of voltage dips which could be tolerated, 3 per cent seemed to be the figure as an occasional event and twice as much on odd occasions, but even such figures were difficult to obtain when a direct-on switching operation was used on a transmission system. The author suggested reactor starting as an economic method of reducing the starting current, but Mr. Lyon thought that the reactance required would be several times the figure of 10 per cent mentioned by the author.

Mr. J. Douglas mentioned that with very large heads the runaway speed was much closer to the running speed. The Hiwassee overspeed figure was about 69 per cent and figures around 40 per cent overspeed had been quoted for very high heads with a single unit.

Rotational Speed

Mr. V. G. Newman said that savings in capital cost could be obtained by increasing the size of the unit or alternatively increasing the rotational speed. Probably in future many pumped-storage stations would be underground so that it should be possible to achieve at reasonable cost the necessary submergence to make possible a considerable increase in rotational speed. He had been told by turbine manufacturers that for a 200 MVA machine a speed of 375 r.p.m. instead of the normal speed of 167 r.p.m. might be possible.

The author, in reply, agreed that today hydraulic engineers could offer reversible pump/turbine units for heads much in excess of 600ft and possibly over 1,000ft. In their experience of jobs which they had handled with various turbine manufacturers in this country and abroad it had been found that, for the average pumped-storage set, the overspeed was perhaps 40 per cent, and might even be as low as 30-35 per cent. This meant that the machine could be substantially cheaper, because the stresses were lower.

NEW ELECTRICAL EQUIPMENT

Germanium Power Transistors

A series of n-p-n 60 V 6 A germanium alloy transistors for power switching applications has been introduced by SYLVANIA-THORN COLOUR TELEVISION LABORATORIES, LTD., Great Cambridge Road, Enfield, Middlesex. Transistors in the GT 422 series can be used in conjunction with a p-n-p type as a complementary pair for a transformerless radio or servo-amplifier output stage or as series voltage regulators. Other types in the series are rated for 60 V 3 A, 36 V 6 A, and 36 V 3 A. The maximum junction temperature is 85°C.

Non-Synchronous Welding Timer

Multi-stage non-synchronous timing equipment has been added to the extensive range of resistance welding control equipment manufactured by LANCASHIRE DYNAMO ELECTRONIC PRODUCTS, LTD., Rugeley, Staffs. The

Lancashire Dynamo three-stage welding timer

units, designated Series RCW.25, provide a compact assembly suitable for building into resistance welding machines and incorporate switching arrangements for air valves and electromagnetic or ignitron contactors. Three basic units are in production for two, three or four stages of time control. Typical control sequences are "Weld-Forge," "Weld-Hold-Off" and "Squeeze-Weld-Hold-Off," all with facilities for single or repetitive spot operation. The four-stage unit is particularly suitable in view of the increasing use of pressure before weld sequences and enables the conventional pressure switch to be omitted if this is considered desirable. Repetitive spot welding rates of 180 spots per minute have been achieved with this timer.

Fan Heater

A new streamlined version of the "Activair" fan heater has been placed on the market by the KENWOOD MANUFACTURING CO., LTD., Old Woking, Surrey. Finished in two-tone gold, it has push-button controls which give six different heat and fan speed combinations. The maximum loading is 2 kW and the fan is said to be as effective for cooling a room in summer

Kenwood "Activair" fan heater

as it is in winter for heating purposes. In addition, it can also be employed for airing clothes and as a hair dryer. A safety device automatically cuts off the current if the appliance is knocked over or the air flow restricted. The total weight is only 8½ lb and the price is £7 19s 10d plus £1 9s 2d purchase tax in the United Kingdom.

Relay Amplifier

To provide a highly sensitive control circuit for any d.c. operated relay in the range manufactured by B. & R. RELAYS, LTD., Temple Fields, Harlow, Essex, a transistorised amplifier can be fitted integrally with the relay assembly. Up to three stages of amplification are obtainable, depending upon the input signal available, and the amplifiers are suitable for operation in ambient temperatures of between −20°C and +75°C. Transistorised circuits to meet customers' special requirements can also be undertaken.

Mercury Lamp Fitting

An inexpensive fitting for their mercury fluorescent reflector lamps introduced by PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, provides complete coverage for the top of the lamp but does not interfere with light distribution. The type R.7720 fitting comprises a porcelain skirted g.e.s. lampholder having a cast iron top. The latter is stove enamelled white and has a ¾in electrical thread conduit entry. The aluminium body spinning is held between the lampholder skirt and the top cap which is secured by two screws passing through the assembly. The fitting weighs 2¼ lb complete and is priced at £2 5s.

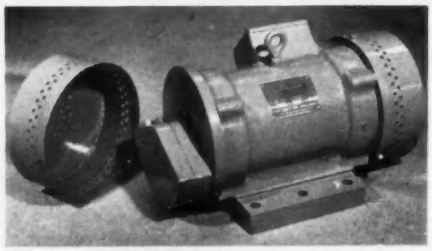
Silicon Controlled Rectifier

Quantity production of a new silicon controlled rectifier will be commenced in January by the Electronic Apparatus Division of ASSOCIATED ELECTRICAL INDUSTRIES, LTD. The new device, which is of the p-n-p-m form, can be regarded as two transistors coupled by a common collector junction. It is the solid-state equivalent of the thyratron. It offers a high impedance in each direction but can be triggered into a low impedance condition in one direction by the application of a small signal to the third electrode. Applications include the control of electric motors, firing of ignitrons, inversion, frequency conversion, static switching, etc. Loads of up to 10 A at 25 to 300 V peak inverse voltage can be handled by the proposed range of these units.

Vibrating Drive Motor

An electric motor for vibrating drives is being produced and marketed jointly by the ENGLISH ELECTRIC CO., LTD., Bradford, and the GRANTHAM ELECTRICAL ENGINEERING CO., LTD., 6, Wharf Road, Grantham, Lincs. The self-contained unit eliminates the mechanical parts associated with an eccentric shaft arrangement, vibration being generated by out-of-balance weights at each end of the motor which can be adjusted by single bolts to give the required output. The motor, which operates from a 3-phase 50 c/s supply at 110-650 V, is totally enclosed, dustproof and weatherproof and is built to B.S. 2613. It has class E winding insulation permitting a temperature rise of 65°C in a surrounding temperature of 40°C. The frame is of nodular cast iron with integral feet, and the shaft is of high tensile steel to withstand the high centrifugal force developed. Because of its vibrating motion, the motor must

Philips mercury lamp fitting



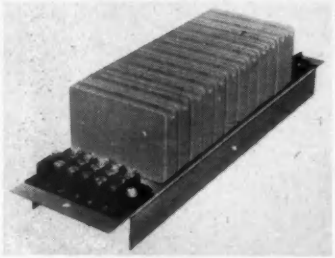
English Electric/Grantham Electrical vibrating drive motor

be mounted on a resilient base. Operating at 1,500 r.p.m. synchronous speed, it has a power output of up to 7,500 lb centrifugal force or 10,000 lb at 3,000 r.p.m.

Electronic Sub-Assemblies

A series of electronic sub-assemblies for use in industrial control systems, data processing equipment, measuring systems and other equipment based on digital circuit techniques has been introduced by MULLARD EQUIPMENT, LTD., Mullard House, Torrington Place, London, W.C.1. The units comprise fully developed circuits and two ranges are available, "Norbits" and "Combi-Elements." The first have been developed to allow industrial firms to build their own sequence control systems without the services of trained electronic engineers, while the second range provides the electronic system manufacturer with a set of standard units representing the most commonly used digital circuits. Both ranges are fully transistorised and operate from 24 V supplies.

The basic "Norbit" unit is a transistor switching element measuring 2½ by $1\frac{3}{16}$ by ½in, and up to twelve can be accommodated, by a single screw fixing, on one channel unit equipped with terminating blocks for input and output connections. The units have long flying leads so that

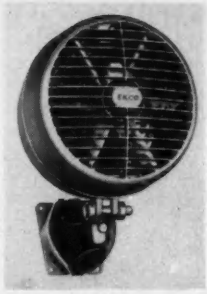


Mullard "Norbit" electronic sub-assemblies

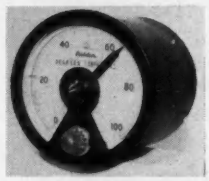
interconnections may be made without intermediate tag-panels for additional wiring, and they are available with outputs of up to 150 W for operating contactors, solenoids, etc. The range of "Combi-Elements" includes flip-flops and other multivibrator circuits, pulse shapers, gate circuits, amplifiers and emitter follower circuits.

Temperature Controller

A precision temperature controller with a differential of 0·5°C, high calibration accuracy and long-term stability has been announced by FIELDEN ELECTRONICS, LTD., Paston Road, Wythenshawe, Manchester, 22. The instrument, which can be mounted at any angle, is housed in a sealed case and occupies a panel space of only 4½in diameter. The scale, which is 9in long, is calibrated directly in temperature and a pointer is set to the required control temperature, between −200 and +500°C with



"Ekco" 3 kW unit heater (E. K. Cole, Ltd.)



Left: Fielden temperature controller

a minimum temperature span of 50°C, by a central knob. A platinum resistance element is used at the temperature measuring point, housed in a ¼in diameter stainless steel sheath. The connecting cable between the measuring point and the instrument can be up to 300ft in length. Electrical contacts give changeover switching at 5 A 250 V and a valve for a pneumatic control relay requires 17 to 20 p.s.i. input.

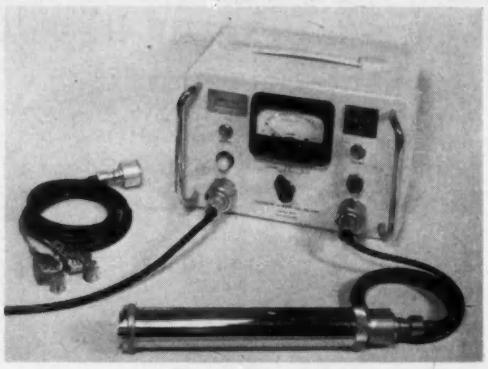
Unit Heaters

A new series of "Ekco" unit heaters has been announced by E. K. COLE, LTD., Southend-on-Sea, Essex. Suitable for use in factories, workshops, large stores, etc., they are available in 3, 5 and 10 kW loadings and each model can be controlled by remote switching. They can also be used with separate thermostats, and hand re-set safety thermal cut-outs are incorporated. The 3 kW heater is supplied with a bracket for mounting on walls or stanchions, while the 5 and 10 kW units are usually suspended from ceiling joists or roof girders. Alternatively, brackets can be supplied at extra cost for mounting on walls or stanchions. All the unit heaters have a polychromatic bronze finish.

Gamma Emission Detector

The mains or battery operated low energy gamma radiation detector, the P.N.I. 1080, developed by PLESSEY NUCLEONICS, LTD., Weedon Road, Northampton, can be adapted to measure plutonium 239 in the human body, americanum, a radioactive substance which will be contained in the plutonium manufactured by reactors in this country, and uranium 235.

The equipment consists of a detector probe connected by up to 6ft of cable to an indicating unit. The probe is a thin, thallium activated, sodium iodite scintillator mounted on the end of a multiplier photo tube. A

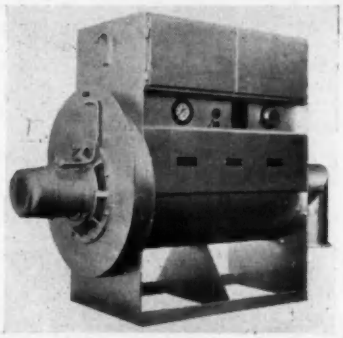


Plessey gamma emission detector

chain of resistors produces the correct potential on the dynodes and the cable matching network ensures optimum signal pulse transfer from the probe to the indicator. The transistorised unit consists of a pulse amplifier, a single channel pulse amplitude analyser, an e.h.v. supply for the photo tube and a display system. The sensitivity of the instrument for direct plutonium radiation is 15 c/s per microcurie and 0·2 per cent of this figure for background radiation.

Electric Mould Dryers

An agreement was recently announced by EFCO, LTD., Netherby, Queens Road, Weybridge, Surrey, by which their subsidiary, the Electric Resistance Furnace Co., Ltd., are to manufacture portable electric mould dryers designed by Brown Boveri & Co., Ltd., of Switzerland. Air, heated in passing through ceramic tubes containing spiral heating elements, is forced through the mould sand by a radially bladed fan driven by a totally enclosed motor. A single switch is used to bring the dryer into operation and to adjust the power input. The air temperature is controlled by a pointer-type mercury thermometer with minimum and maximum contacts switching the heating elements. The dryers will be manufactured in three ratings, 25, 70 and 140 kW, and with two temperature ranges, up to 350 and 650°C.



A 70 kW Brown Boveri type mould dryer

GENERATION and DEVELOPMENT

Domestic Appliance Sales by Area Boards

The Electricity Council's latest return of domestic appliance sales by Area Boards covers the month of September, completing a full year since the first relaxation of hire-purchase restrictions (the controls were completely removed in October, 1958). Some reduction of the high percentage increases compared with a year ago was therefore to be expected. As will be seen in the accompanying

	Month ended 30th Sept.		Twelve months ended 30th Sept.	
	Total	Change %	Total	Change %
Cookers ...	29,776	+ 29·9	336,793	+ 45·9
Water Heaters:				
Immersion ...	17,453	+ 18·8	191,432	+ 21·3
Storage ...	5,148	+ 24·6	58,761	+ 26·8
Wash Boilers...	6,534	− 11·6	72,131	− 9·5
Washing Machines ...	16,140	+ 95·3	169,427	+121·0
Refrigerators...	13,688	+126·7	164,612	+163·6

table, the September increases were generally lower than those for the twelve months, but—excluding wash boilers—remained substantial. Compared with August, sales of electric cookers rose from 26,102 to 29,776 and of washing machines from 13,494 to 16,140. On the other hand there was a seasonal decline in refrigerator sales from 17,434 in August to 13,688 in September. It should be borne in mind that the figures are confined to sales by Area Boards and represent only a part of total sales throughout the country.

Improved Supply to Romney Marsh

A meeting of representatives of the South Eastern Electricity Board, the Central Electricity Generating Board and the National Farmers' Union was told that although consumers on Romney Marsh would not be able to obtain supplies from the temporary power line to be erected to the Dungeness nuclear station, the South Eastern Board was planning a further 11 kV line from Dymchurch which should greatly improve service to the marsh district. In view of this the Romney Marsh Branch of the N.F.U. is not to object to wayleaves for the temporary line to Dungeness.

New Grid Substation

Electricity Board workmen were treated like an invading army, to be repelled at all costs, when they went into an area to build new power installations, said Mr. D. Bellamy, chairman of the Yorkshire Electricity Board, on 3rd November at the opening of the East Hull grid supply point in Somerdon Road. Every year the Board had to build three units similar to the new East Hull supply point, he said. Instead of being met with hostility, they should be welcomed with open arms, because they were ensuring that everybody had a safe and cheap supply of electricity as speedily as possible. The new supply point had a capacity of half that of Sculcoates power station and could be made equal to it quite easily. There were often demands that they should use underground cables. But these would cost 17 times as much as the overhead lines to which some people objected.

After being taken round the substation and shown a film, "Talking of Service," the guests were entertained at lunch in the Guildhall.

Houses with Lighting Circuits Only

Among the representations from consumers dealt with recently by the Essex Local Committee of the Eastern Electricity Consultative Council was one from a Dagenham consumer who said that he lived in an area where it was not possible to use modern electrical appliances because the mains were inadequate. The sub-area manager informed the Committee that in a large part of Dagenham there were approximately 16,000 consumers in houses, built just after the 1914-18 war, which were connected to a system laid down for lighting load only. The Board intended to reinforce the system progressively over a period of five years at a cost of some £1 million. It was intended to undertake this work in conjunction with the London County Council and the Board hoped that the L.C.C. would, at the same time, provide suitable electrical installations in the houses.

Alderman W. J. Bennett, chairman of the Consultative Council, commented that it was a short-sighted policy to wire houses for lighting only. They could understand the frustration of people who saw advertisements for modern electrical equipment which they could not use.

Aluminium Columns for Group "B" Lighting

Low weight, ease of installation and resilience to shock are among the advantages claimed for the aluminium columns used for the Group "B" lighting scheme at Kempston, Bedfordshire, which was switched on last week by the chairman of the Urban District Council, Mr. L. R. Cooper, J.P. A.E.I. "Residential" lanterns, with twin "Mazda" 2ft 40 W fluorescent tubes, are fitted to all the columns.

The columns were manufactured by the A.E.I. Lamp & Lighting Co., Ltd., from specially formed alloy extrusions, as described in the *Electrical Review* of 30th October. The extrusions are interlocked in a triangle to form the tapering 15ft shaft and since this weighs only about 35 lb it can be carried and erected by one man without mechanical help. At Kempston a team of four men using hand augers and picks and shovels erected the complete installation of 450 columns with their lanterns in three working weeks, which included the time spent in learning the new technique.

In any street lighting scheme some of the columns will inevitably be damaged by vehicles. One of the columns at Kempston, which had been hit by a farm vehicle, was still capable of being straightened and used for temporary service after it had been knocked over at an angle, experimentally, four more times. In addition to the inherent safety to both pedestrians and drivers of a column that absorbs shock and remains up and in one piece when others snap or shatter, there is considerable advantage in being able to temporarily straighten a column which is only slightly damaged. It can then be removed and replaced at a convenient time by two men with a light van or handcart, when the cost of labour will in many cases be covered by the scrap value of the column. The oxidisation of the R.T.I. 441-E.P. alloy used is superficial and is a protection on the surface of the metal which does not in any way affect the strength or the life of the column.

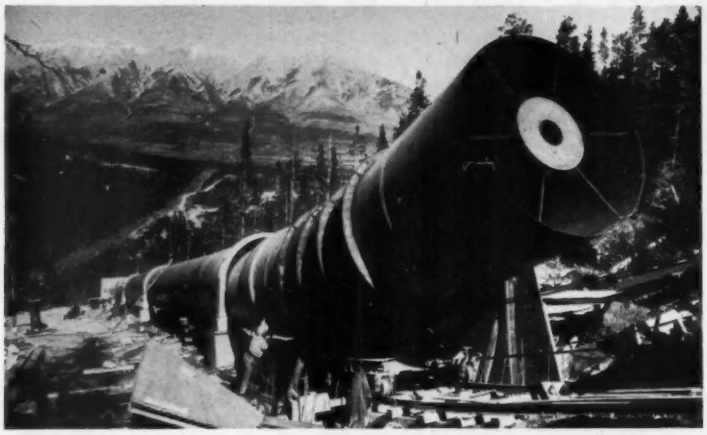
The columns were erected by S. Inston and the cable connections made by C. Morris Contractors, Ltd.

OVERSEAS

Hydro and Thermal Power in Alberta

Over a large part of the Canadian province of Alberta power supply is in the hands of Calgary Power, Ltd. In the main, the company's load has been met over the years by the construction of hydro-electric plants on the Bow River and its tributaries, west of Calgary. These plants now serve an extensive high voltage transmission system which is interconnected with the other major electric utility systems in Alberta, and the East Kootenay Power Co. in British Columbia. Eleven hydro plants varying in capacity from 3,600 to 67,450 h.p. have been constructed, representing approximately one-sixth of the estimated potential power in the province. Since the discovery of the Leduc oilfield, the company has carried on a heavy construction programme to meet the rapidly growing power load. Between 1947 and 1958 it added 217,000 h.p. of hydro capacity to its system.

Plans at present in hand are based



Penstock for the Spray hydro project, Calgary

upon combining the desirable characteristics of both thermal and hydro plants, the former being used for base load while hydro plants with storage reservoirs or large headponds can be built to operate at high rates over peak load periods. One of the larger projects is the Brazeau River hydro development, the first 200,000 h.p. unit of which should be ready by 1963-64. This plant will help to meet the widely varying loads which are typical of residential and commercial consumers in Alberta. Additional units, totalling 102,000 h.p., are also under construction at the Spray and Rundle hydro schemes and are scheduled for commissioning next year. By 1963-64 the company's hydro plant capacity will total 625,000 h.p. and its thermal capacity 307 MW.

The accompanying illustration shows the penstock of the Spray hydro expansion project under construction. The 15 ton bend section being placed in the foreground will be encased in a concrete anchor block. The steel penstock from this section to the power house is 1,376ft long. High tensile "T-1" steel is being used for the first time in this penstock, since a thinner gauge ($\frac{7}{16}$in) can be used which therefore reduces tonnage.

The Wabamum station, where two Metropolitan-Vickers 66 MW sets have been installed, was the first thermal power plant built by the company. A third unit, of 150 MW, is planned for operation in 1962. At present the station burns natural gas but coal will eventually be used.

Tasmania's Water Power

Matching the scale of the Snowy Mountains scheme on the Australian mainland, the potential hydro-electric development in Tasmania is estimated at more than 3 million h.p. When these resources are fully harnessed the annual output of power will be twice as great as from the Snowy scheme while the cost per kWh will be much less. At present the installed capacity is 684,000 h.p.; this will be raised to 1·2 million h.p. when works now under construction are completed.

The population of Tasmania is about 335,000 and the use of electricity per head is 6,000 kWh a year, more than three times the consumption per head in Australia as a whole. The Electrolytic Zinc Company of Australasia and the Australian Aluminium Production Commission take large supplies in bulk and, because of its ready availability and relative cheapness, electricity is in general use for cooking, water heating and space heating. The transmission and distribution system extends to every inhabited part of the State and about 98 per cent of all homes and farms are connected. Charges are uniform throughout the State, farmers in country areas paying no more than a flat-dweller in the capital. This, it is believed, has been an important factor in attracting new workers to farming areas.

By far the greatest enterprise of the Hydro-Electric Commission is the Great Lake power development scheme which, when completed—probably in 1966—will have cost nearly £28 million. Generators with a total capacity of 300 MW will be installed at Paotina, Tasmania's first underground power station. When this station is in operation the output of the State hydro-electric system will be increased by 880 million kWh a year, equal to the entire output in 1949. One of the notable engineering feats will be the driving of a four-mile tunnel through the rocky escarpment of the 4,200ft high Western Tiers. At Paotina power will be generated by a fall of 2,750ft in a single stage. From the power station, 500ft underground, the water will pass through a tailrace tunnel, discharge into a canal and then run through a regulating pond into a channel following the course of Brumby Creek to the Lake River. Another part of the project, the Arthurs Lakes diversion, consists of a clay-core rockfill, a dam about 50ft high at the outlet from Arthurs Lakes, an approach channel and a pumping station on the western shore of the lake. There will be a rising main 4,000ft long and then three miles of artificial channel to carry the water to the Great Lake.

The latest annual report of the Commission shows that in 1957-58 a total of 2,002 million kWh was sold, 6·3 per cent more than in the previous year, and revenue rose from £5,803,146 to £6,244,379, the net result being a small profit of £9,822 (against £346,403).

Public Transport Association

A plea for the relaxation of the fuel tax and the removal of restrictions on "box dimensions" was made by Mr. A. F. R. Carling, chairman of the Public Transport Association, at the Association's annual dinner held on 12th November at the Connaught Rooms, London.

Mr. Carling was replying to the toast to the Association proposed by Mr. E. Marples, Minister of Transport. He said that Mr. Watkinson, the former Minister of Transport, had left Mr. Marples with much to do, not only as regards roads, but also in persuading the Chancellor to adopt policies more helpful to bus transport. The Association could not understand why its basic raw material, fuel, should be taxed so heavily. The Minister of Transport and the Chancellor of the Exchequer were trying to milk the same cow. The Minister wanted the rural services to be maintained and the Chancellor wanted the money.

Regarding bus dimensions ("box dimensions"), the Association had been considering, lately, the limits over here as governed by statutory instrument, and it felt sure that the time was ripe to bring Britain into line with modern Europe. That meant a measure of relaxation, and they were now in touch with other associations with a view to a joint approach to the Minister of Transport. The Association also thought that the present speed limit outside built-up areas was out of date. Mr. Carling also proposed the toast to the guests, and the response was made by Lord Mancroft.

Liverpool-Crewe Resignalling

In connection with the railway electrification between Liverpool and Crewe two new power signal boxes are to be built at Edge Hill and Weaver Junction and the whole of the 36-mile track is to be equipped with colour light signals in place of the present semaphores. There will be continuous track circuiting, semi-automatic controlled signals instead of manual block working, and the automatic warning system of train control will be installed.

Financial Section

STOCKS and SHARES

IN the industrial markets of the Stock Exchange there has been further evidence of the weight of money waiting to take advantage of any setback in share prices. A fresh wave of buying made short work of the reactionary tendencies which made their appearance in the early part of this month and carried the price indices to yet another record height. The movement paused again after the Governor of the Bank of England's references to the " marked and sometimes slightly disquieting boom " in equities. By the beginning of this week, however, there was still little sign of any serious misgivings to mar the sustained optimism of investors large and small. Much of recent company news has helped to maintain it.

Lucas Results

Joseph Lucas (Industries) £1 shares have been well supported, up to 67s ex dividend, since the appearance of the preliminary profits statement covering the year ended in July and the declaration of a 12½ per cent dividend, which compares with last year's total (including a special interim) of 10 per cent. Net profits at just over £2½ million after all charges, increased by some £280,000, and it appears that about two-thirds of the distributable surplus is being retained in the business. On the higher rate of dividend the yield for the shares is still barely 3¾ per cent, and evidently takes into account the evidence that the motor industry's output has now accelerated to a rate considerably higher than that attained during much of the company's last financial year.

Company Meetings

Considerably more difficult trading conditions in the current year are anticipated in the chairman's review accompanying Crompton Parkinson's full report. While he expects a general increase in demand, competition may be intensified in many of the group's traditional fields. For the past year, net earnings were better than maintained, and the 2 per cent increase in the ordinary dividend, to 14 per cent, was regarded as justified by the year's results and by the strength of the financial position. A one-for-four scrip issue is expected to be distributed at the end of the year. Meanwhile the 5s shares have been steady at 18s. At the Holophane annual meeting, business was shown by the chairman to have been affected in the latest year by a slow response to the ending of the credit squeeze on capital programmes, but net profits (after tax) were maintained and the dividend raised from 22½ to 26 per cent. At 19s 6d the 5s shares yield over 6½ per cent.

B.I.C.C. Interim

There was a net improvement of about 1s 9d in the price of British Insulated Callender's Cables £1 shares, to 55s, over a week which included first the news of the projected world cable link, followed by the company's interim dividend declaration and progress report. The payment remains unchanged at 4 per cent on capital

Price Changes in

Company or Board	Nom. Value	Middle price 16th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1959 Highest	1959 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	81	+½	3	3	3 14 0	81	77½
Brit. Elec. 1974/77	100	78	+½	3	3	3 17 0	78	74½
Brit. Elec. 1976/79	100	81	+½	3½	3½	4 6 6	81	77½
Brit. Elec. 1974/79	100	91½		4¼	4¼	4 12 9	91½	87½
Overseas Electric Supply								
Calcutta Elec.	£1	19/6		6·8†	7†	11 15 0	19/6	16/-
East African Power	£1	21/6	−1/-	7½	8	7 8 9	22/6	19/3
Nigerian Elec.	£1	18/-	+6d	8	8	8 18 0	18/-	13/-
Perak Hydro-Elec.	£1	14/6	−6d	12½	10	13 16 0	15/-	12/3
Electrical Shares								
Aberdare Holdings	5/-	17/6	−3d	17½	17½	5 0 0	18/9	15/6
Aerialite	1/-	9/6x.d.	+3d	54	54	5 12 6	12/3	7/9
Allen, W. H.	£1	53/9		11	12	4 9 3	53/9	43/-
Allied Insulators	5/-	23/6		—	20‡	4 5 0	23/6	18/9
Anglo-Portuguese Tel	£1	30/9		9	9	5 17 0	30/9	26/6
Aron Elec. Ord.	£1	50/-		15	15	6 0 0	62/6	50/-
Assoc. Elec. Ord.	£1	64/6	+9d	15	15	4 13 0	67/-	53/9
Automatic Tel. & El.	£1	81/3	+1/3	17	17‡	4 3 9	82/6	71/3
Babcock & Wilcox	£1	44/-		13½	13	5 18 3	52/6	43/9
Bakelite	10/-	39/-	+1/-	15	15	3 17 0	40/-	22/-
Baldwin, H. J.	2/-	2/6		20	—	—	3/-	2/-
Berry's Electric	5/-	29/9	+6d	10	20‡	3 7 3	30/-	7/3
Bowthorpe Holdings	2/-	10/6	−3d	25	27	3 0 6*	10/9	8/-
British Elec. Traction: Def. Ord. " A "	5/-	47/-	+1/-	25	35	3 14 6	47/6	35/6
B.I. Callender's	£1	55/-	+1/9	12½	13½	4 18 3	50/6	44/9
B.I. Callender's 6% Pref.	£1	21/-		6	6	5 14 3	21/-	19/9
British Thermostat	5/-	23/-		30	35	3 16 0*	28/-	18/6
British Vac. Cleaner	5/-	11/-	+9d	10	7½*	3 8 3	11/3	4/6
Brook Motors	10/-	59/-	−6d	25	24½*	4 1 6	59/6	46/-
Bulgin, A. F.	1/-	11/6		45	50	4 7 0	11/6	6/9
Bulpitts	5/-	18/6		—	15	4 1 0	18/9	10/-
Burco Dean	5/-	19/-	+1/-	22½	16*	4 4 3	19/-	12/3
Cable & Wireless: Ord.	5/-	18/6	+6d	10	10*	2 15 6	18/6	12/3
4% Loan	100	96		4	4	4 3 3	96	93
Chloride El. Storage " A "	£1	67/6	−9d	17½	20‡	3 19 0*	72/-	43/8
Clarke Chapman	£1	57/6		27½	13‡*	4 15 9	66/3	52/6
Cole, E. K.	5/-	25/6	+1/-	17½	20	3 18 6	25/6	17/3
Contactor Switchgear	5/-	14/6	+6d	14	14	4 16 6	16/9	12/-
Cossor, A. C.	5/-	7/6	+3d	Nil	5	3 6 9	9/-	6/3
Crabtree	10/-	46/3		20	20	4 6 6	48/9	28/-
Crompton Parkinson	5/-	18/-		12	14	3 17 9	19/-	11/9
Davis & Timmins	5/-	22/-		18	20	4 11 0	22/-	14/6
De La Rue	10/-	65/-	+5/-	17½	20	3 1 6	66/-	30/3
Decca " A "	10/-	43/9	+2/-	43‡	50	4 11 6*	44/3	33/3
Desoutter	5/-	31/-		32½	23‡*	3 10 3	31/-	19/-
Dewhurst	2/-	9/6	+6d	20	20	4 4 3	9/6	7/3
Dictograph Tel.	2/-	9/6	+3d	20	20	4 4 3	9/6	7/-
Dubilier Condenser	1/-	5/3		20	25	4 15 3	5/6	3/3
Duport	5/-	16/3	+2/6	25	12½*	3 17 0	18/9	10/3
E.M.I.	10/-	74/6	+9/6	15	20*	2 13 9	75/-	48/-
Electrical Apparatus	5/-	13/3	−1/9	14½	14½	5 9 6	16/6	13/-
Electrical Components	5/-	14/-	+1/6	12½	15	3 11 6*	14/-	7/-
Elec. Construction	£1	35/9		8½	9	5 0 9	37/-	27/9
Elliott-Automation	5/-	28/9		—	10‡	1 14 9	30/6	16/9
English Electric	£1	46/3		14	14	4 1 0*	48/9	37/10
English Electric 3¾% Pref.	£1	13/6	+6d	3¾	3¾	5 11 0	13/6	12/3
Ericsson Tel.	5/-	28/-	+6d	12†	13†	3 15 9	28/-	22/3
Ever Ready	5/-	25/6		20	27½‡	3 4 6*	28/-	13/3
Falk Stadelmann	£1	35/-		10	10	5 14 3	35/-	25/-

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.
* After scrip issue. † Free of income tax ‡ Dividend indicated

increased since last year to £18·8 million as a result of the acquisition of Telegraph Construction & Maintenance and Scottish Cables. With the inclusion of the former company's contributions, and of the latter's for part of the time, group sales were materially above last year's figures, while the trading surplus was just about level with the second half of 1958, and some 20 per cent better than the first half of that year. Given similar results for the rest of this year, it is calculated that earnings are running at a level equivalent to about 30 per cent on the present capital, giving plenty of cover for the current 13½ per cent rate of dividend. On that basis the shares are showing a yield of close on 5 per cent.

Electrical Investments

Company or Board	Nom. Value	Middle price 16th Nov.	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1959 Highest	1959 Lowest
Electrical Shares—continued						£ s d		
G.E.C.	£1	43/9	+1/3	10	10	4 11 6	48/-	31/3
G.E.C. 6½% Pref.	£1	23/-		6½	6½	5 13 0	23/-	20/3
General Cables	5/-	9/-	+9d	24	15	8 6 9	9/3	7/6
Greenwood & Batley	£1	115/-		20	30	5 4 3	115/-	75/-
Hackbridge Holdings	5/-	16/3		20	20	6 3 0	19/3	14/3
Hackbridge & Hewittic	5/-	15/-		20	20	5 0 0*	15/6	10/6
Head Wrightson	5/-	23/9x.c.	−1/3	20	14‡*	2 19 0	26/-	16/6
Heatrae	2/-	10/-		20	20	4 0 0	10/-	7/6
Holophane	5/-	19/6	−6d	22½	26	6 13 3	20/-	14/9
Hoover	5/-	98/-	+3/-	50	60	3 1 3	98/9	55/-
I.C.I.	£1	56/3	+1/9	12	8*	2 17 0	58/9	33/-
Intl. Combustion	5/-	36/-	−3d	25	30‡	4 3 3	38/6	29/9
Intl. Computers & T.	£1	76/-	+3/6	—	8‡	2 2 3	78/9	57/6
Johnson & Phillips	£1	21/-		5	5	4 15 3	30/6	20/-
Lancashire Dynamo	£1	47/6		11	12½‡	3 19 0*	48/9	31/6
Laurence Scott	5/-	18/9		15	15	3 9 0*	18/9	14/-
Lister, R. A.	£1	49/-	−1/-	10	12½	5 2 0	50/6	32/9
Lucas, J.	£1	67/-x.d.		10	12½	3 14 9	70/-	43/3
Marconi Marine	£1	42/-		10	10	4 15 3	48/6	40/-
Marryat & Scott	2/-	11/9	+6d	37½	22½*	3 16 6	11/9	8/6
Mather & Platt	£1	50/-	+1/-	15	10‡*	4 5 6	51/6	41/3
Metal Industries	£1	68/-	+1/9	14	14	4 2 3	68/-	39/9
Midland Elec. Mfg.	£1	48/9		12½	10*	4 2 0	48/9	41/6
Morphy-Richards	4/-	32/6	+2/6	20	25	3 1 6	34/-	18/-
Murex	£1	62/6	+4/6	17½	15	4 16 0	62/6	42/-
Newman Ind.	2/-	3/3		10	10	6 3 0	3/6	2/3
Oldham & Son	1/-	3/-		17½	17½	5 16 9	3/3	2/6
Parsons, C. A.	£1	53/-	+1/-	7½	8½‡	3 1 9	58/-	45/9
Philips' Lamps	Fl.10	132/6	+2/6	14	14	2 0 0	132/6	88/-
Plessey	10/-	46/3	+3/9	20	13*	2 11 0	46/3	23/6
Pye	5/-	22/6	+2/6	12½	12½	2 15 6	22/6	13/9
Pyrotenax	5/-	47/6	+6d	—	34	3 11 6	47/6	33/9
Reliance Clifton	5/-	23/-		15	15	3 5 3	24/6	17/6
Reyrolle	£1	91/6	+6d	17½	17½	3 16 6	98/-	85/9
Rheostatic	4/-	12/-		12½	12½	4 3 3	12/-	8/3
Richardsons Westgarth	10/-	12/3		8½	8½	6 16 0	15/3	11/6
Simon-Carves	5/-	30/-	−9d	25	25	4 3 3	32/-	28/6
Smith (England), S.	4/-	21/-	+3d	12½	17½	3 6 9	21/-	11/6
Southern Areas	£1	15/-		Nil	Nil	Nil	15/-	10/6
Strand Elec.	5/-	17/3		15	20	5 16 0	18/-	8/6
Sturtevant	5/-	23/6		15†	15†	5 5 9	23/6	17/-
Sun Elec.	5/-	16/3		25	25	3 17 0*	16/9	8/3
Switchgear & Cowans	5/-	15/9	−3d	22½	15*	4 15 3	16/-	10/3
T.C.C.	10/-	58/6	+1/-	25	25	4 5 6	58/6	38/-
Telephone Mfg.	5/-	7/-		10	10	7 2 9	7/3	4/9
Telephone Rentals	5/-	22/6	+3/6	12½	12½*	2 15 6	22/6	11/9
Thompson (John)	5/-	20/-	+6d	25	25	6 5 0	25/6	19/6
Thorn Elec.	5/-	50/-	+4/6	17½	20	2 0 0	50/-	26/3
Thornycroft	£1	23/3x.d.	−1/-	.7½	6	5 3 3	30/-	20/6
Tube Investments	£1	118/9x.d.	+2/9	17½	20	3 7 3	120/-	71/6
Vactric	5/-	44/6	+1/-	25	37½	4 4 3	46/6	26/3
Veritys	5/-	1/6		12½	2½	—	5/-	1/3
Walsall Conduits	4/-	15/-		22½	22½	3 8 3*	15/3	10/8
Ward & Goldstone	5/-	57/6		25	30	2 12 3	57/6	30/6
Watford	2/-	13/3		25	25*	3 15 6	14/9	7/6
Westinghouse	£1	52/6		10	10	3 16 3	53/9	39/6
West, Allen	5/-	14/6		12½	11½*	4 0 6	14/6	11/9
Wolf Electric	5/-	9/9		10	10	5 2 6	9/9	7/9

Profit Margins

In the section of the market for cable manufacturers' shares, the main point for concern—and the one held responsible for the above-average yields—continues to be the effect of fierce competition upon profit margins. In the B.I.C.C. interim statement there is little evidence of improvement in that respect, for the ratio between sales of £63 million and the trading surplus of £4·8 million (before tax and depreciation) is 7·6 per cent, compared with 7·5 per cent in the corresponding half of 1958, and 8·5 per cent in the second six months. From this point of view, conditions are forthrightly declared by the chairman of Aerialite, in that company's annual report, as a "disgrace to an organised country." He notes the discussions in progress between the big groups, but sees no sign of an end yet to uneconomic price-cutting.

Automatic Telephone

Share capital of Automatic Telephone & Electric consists at present of £3·44 million ordinary, £260,000 "B" deferred and £100,000 "A" deferred stocks. The last-named carries the right to exercise 50 per cent of total votes exercisable at general meetings, and is held by the British Insulated Callender's Cable Company. Partly with the object of amending this abnormal voting structure, steps are now being taken to amalgamate the three issues into one class of ordinary stock, in which all voting rights would be vested. By way of compensation, B.I.C.C. would receive £100,000 of a proposed scrip issue of £190,000 ordinary stock, the balance going to the existing ordinary stockholders. In the market the proposals were welcomed both in principle and in detail.

Prices

In the latest advance of industrial share prices, investments connected with the booming consumer goods industries were again prominent, but with the yield on many of them down to the 3 per cent mark, more attention was being paid to the relatively good returns of around 4½ per cent still available from such leaders of the capital industries section as G.E.C. and A.E.I. Some of the largest gains however were recorded in the radio and electronics group, where E.M.I. were the star turn in rising from 65s to 74s 6d. Thorn Electrical replaced the previous week's setback of 3s 3d with a gain of 4s 6d. Pye went further ahead, to 22s 6d, on the strength of the company's encouraging progress report, while Decca and E. K. Cole were also strongly supported. Hoover, Berry's Electric and Morphy-Richards were all in favour again.

REPORTS and DIVIDENDS

Crompton Parkinson, Ltd.—The main figures in the accounts for the year ended 30th June last were given in our issue of 6th November.

In his review of the year, which has been circulated to stockholders, Mr. A. Parkinson (chairman) says that it opened with prospects of a revival in industrial and commercial activity which has since raised certain sections of the company's business activity to new high levels. This revival has been slow to spread to those fields of capital investment with which the company is most closely concerned, but it is hoped that improvement in this sphere will now gather momentum. It should be realised that the national productive capacity for some of their standard products is in excess of both British requirements and the immediate demand for these products from overseas. This inevitably has led to intensified competition and to price reductions which in turn have resulted in narrowing profit margins. Nevertheless they have succeeded in achieving an overall increase both in output and sales of many of their products and profits have been raised to record levels.

Dealing with the group's overseas activities, Mr. Parkinson says that in Australia it has been mainly in the field of the heavier capital equipment that orders have been shortest, but in quality and competitiveness their Australian organisation has proved well able to meet the position and during the second half of the year there was an improvement in orders for transformers and other large products. Whilst the production of the smaller motors, which are made at their new works in Campbelltown, New South Wales, has been affected by increased competition, they have had a healthy and progressive year both for larger industrial motors and switchgear.

In India their activities continue at a high level with both factories of their associated manufacturing company fully extended. The demand for their products has been most satisfactory and at the close of the year the total value of unexecuted orders was at new and record levels. The market for the heavier type of plant, and in particular for transformers, is, however, likely to become more competitive. They were anticipating this competition and further increases in the demand for other products by making additional improvements at Worli Works, where a new layout and organisation is made possible by the opening of the Kanjur factory. Both their associated selling companies, Greaves Cotton and Crompton Parkinson Private, Ltd., and the Crompton Engineering Co. (Madras) Private, Ltd., have made substantial progress during the year.

In Canada further economies have been made during the year and the factory has reduced to a new low level the expenses of the manufacturing operation in that country. In spite of these efforts the trading of the company is still carried on at a loss.

Rustyfa, Ltd., the consortium of companies of which they form a part, and which was set up to supply a complete motor-tyre factory to the U.S.S.R., has now received a similar contract from Rumania.

Turning to the group's United Kingdom activities, the chairman says that at Chelmsford works the manufacture of traction equipment for the British Railways' modernisation scheme has necessitated great activity. During the year a further important order was placed with the company by the British Transport Commission for complete sets of locomotive equipment.

The Instrument Department now produces a new range of miniature instruments, and in the manufacture of switchgear a degree of integration has been found possible between the Chelmsford and Manchester ranges which will result in improvements in quality and economies in manufacture. The Contract Department has shown a steady expansion of business both at home and overseas.

At Doncaster the transfer of the lighting fittings factory from buildings owned by the Ministry of Supply to a modern factory which is the property of the company has been completed.

Towards the end of the year the C.E.G.B. awarded Atomic Power Constructions, Ltd., of which their company is a founder member, a contract for the construction of a nuclear power station at Trawsfynydd. Atomic Power Constructions, Ltd., has now come to an arrangement with the G.E.C.–Simon-Carves Atomic Energy Group whereby the two consortia will collaborate in the design and construction of British nuclear power stations. Since the end of the financial year their interest in Radio & Television Trust, Ltd., has been disposed of. With regard to research and development, improved facilities include the inauguration during the year of a new laboratory at the Derby works.

Referring to the radical changes which have occurred during the last twelve months as a result of the cessation or alteration of the activities of many of the trade associations, Mr. Parkinson says that a fortunate result of the company's past policy is that it is equipped both with the financial and physical resources to meet the very competitive position which has resulted.

Mr. Parkinson thinks that there will be a general increase in demand during the current year but that they will be faced with intensified competition in many of those traditional fields from which they normally derive the principal part of their income.

British Insulated Callender's Cables, Ltd.—The half-yearly statement to 30th June last includes the figures of the Telegraph Construction & Maintenance Co., Ltd., from January, 1959, and of Scottish Cables, Ltd., from 1st April last. This shows group sales of £63 million, as compared with £57 million for the preceding half-year to 31st December, 1958, and with £53 million for the corresponding half-year to June, 1958. Group net profits, before exceptional items, total £1,791,000 (against £1,862,000 and £1,208,000 respectively). With the addition of £8,000 exceptional items which relate mainly to tax liabilities adjustments, the total net profit is £1,799,000. The interim dividend is 4 per cent (unchanged) on capital increased under the acquisitions of the Telegraph Construction & Maintenance Co. and Scottish Cables.

Holophane, Ltd.—The annual meeting was held on 12th November, Dr. S. English (chairman) presiding. The directors in their report to shareholders, stated that there was a fall in the year in the volume of business handled, much of which was due to the slowness in the re-introduction of the capital expenditure programmes deferred at the time of the credit squeeze, and there had been no lifting of the import restrictions which were retarding overseas sales. At the same time there was a further rise in the cost of materials and in operating expenses and, as it was necessary to maintain stable selling prices, a reduction in the trading profit ensued. On the other hand taxation rates had been reduced and as a result there was a credit for tax over-provided in the previous year, while the charge for the current year was proportionately lower. The net balance was £53,939, which was an improvement on last year.

Aerialite, Ltd.—The main figures in the accounts for the year ended 31st May last were given in our last issue. Mr. L. S. Hargreaves (chairman) states that the Congleton factory is running on a good profit basis. An extension just completed will enable the company to add a number of new products to its range. The Wythenshawe and Stockport factories are also running on a good profit basis. During the year their holdings in Aycliffe Cables, Johannesburg and Salisbury, were sold at a capital profit.

The Plessey Co., Ltd.—The profit on trading for the year to 30th June last amounts to £2,206,914, as compared with £1,350,110 for the preceding year, and after adding interest, the total is £2,236,119. Taxation absorbs £1,009,342, and the net balance is £1,077,029 (against £523,736). General reserve receives £600,000. It is proposed to pay a final dividend of 7 per cent on capital trebled by a scrip issue, making a total equivalent of 13 per

[*Continued on page 721*

Financial Section (*Continued*)

cent (against 10 per cent). The balance carried forward is £1,536,042 (against £1,257,331 brought in).

The Calcutta Electric Supply Corporation, Ltd.—The annual meeting was held on 12th November, Sir Harry Burn (chairman) presiding. In his statement, which had been previously circulated, the chairman said that during the year ended 31st March last there were increased sales of energy to all classes of consumers with the exception of traction. For the most part the increased demand was from industrial consumers. The total energy sold increased from 1,501 million kWh to 1,677 million kWh, a rise of 167 million, as compared with an increase of 107 million in the previous year. The Calcutta Tramways Co., Ltd., was the sole consumer for traction purposes and the large decrease in sales for this purpose was due to the six weeks' strike by tramway employees in August and September, 1958.

The Perak River Hydro-Electric Power Co., Ltd.—Mr. H. G. Balfour (chairman) presided at the annual meeting held on 12th November. In his circulated statement, the chairman said that the operations during the year under review were adversely affected to a greater degree than during the previous year by the tin export control regulations under the International Tin Agreement. It was calculated that during the previous financial year the permissible export amount of tin for Malaya was 46,000 tons, while in the year under review the exportable amount was reduced by 30 per cent to 32,521 tons. Over 85 per cent of the company's output of electricity was taken by the tin mining industry and there was a direct relationship between the operation of the tin restriction scheme and the volume of the company's business. Last year the sales of electricity totalled 331·8 million kWh, as compared with 230·2 million for the year under review, a decrease of 101·6 million kWh, or 30 per cent, corresponding to the reduction in the exportable amount of tin for Malaya. The year under review was an exceptionally bad water year, the effective flow of the Chendorah River having been the lowest for twenty-nine years. As a result only 142 million kWh was generated at the Chendorah hydro-electric power station, a shortfall of 48 million kWh which had to be generated in the thermal power stations. During the year 50 miles of high voltage transmission lines were constructed and energised and 44 miles of line dismantled following the changing mining requirements of consumers. The two new 12 MW generating sets at Malim Nawar power station, with ancillary boiler plant, water cooling tower, etc., were brought into operation during the year.

Since the end of the financial year the permissible export amount of tin for Malaya for the period to the end of December next had been increased, and now represented a quota rate of 71 per cent, as compared with an average quota rate of 54·6 per cent during the year under review.

Johnson & Phillips, Ltd., are not paying an interim dividend. In making this announcement the directors state that, following the abandonment in May last of the home price arrangements in the cable industry and the considerably increased price competition on the plant side, particularly in transformers, many branches of the electrical industry are, and have been for some months, engaged in a violent struggle for markets. As a result, present selling prices for most of the company's range of products are at such low levels that, despite every effort to increase efficiency, profits are extremely low and in some cases non-existent. In no branch is competition more intense than in cables. Trading results from overseas are still disappointing. Demand for cables is, however, at higher levels than in 1958 and in the first nine months of the current year the value of orders taken shows a substantial advance.

The De La Rue Co., Ltd., is paying an interim dividend of 5 per cent (unchanged) on increased capital.

New Companies

Edis & Co. (Electrical), Ltd.—Registered 23rd October. Capital £2,000. Manufacturers of and dealers in electrical goods, etc. Directors: J. Edis and G. U. O'Hara. Regd. office: Eclipse Yard, West Gate, Mansfield, Notts.

G. W. Instruments, Ltd.—Registered 22nd October. Capital £1,000. To invent and design, develop and make component parts or complete units connected with industrial, agricultural, marine, commercial or research work with special emphasis on the engineering sections of these activities and particularly in the electrical, electronic, ultrasonic and nucleonic aspects, etc. Regd. office: 27, Martin Lane, Cannon Street, E.C.4.

H. Balchin Electrical Services, Ltd.—Registered 14th October. Capital £4,000. Manufacturers and repairers of, agents for and wholesale and retail dealers in artificial lighting apparatus, electrical plant and machinery, radio and television sets, etc. Directors: R. A. Abbott and G. E. Core. Regd. office: High Street, Wisborough Green, Sussex.

Krakat Electrics, Ltd.—Registered 16th October. Capital £100. Electricians, mechanical and radio and general engineers, etc. Regd. office: 138/9, Bush House, Centre Block, Aldwych, W.C.2.

Vallance Electrical Engineers, Ltd.—Registered 13th October. Capital £20,000. Electrical engineers and contractors, etc. Regd. office: Gathorne House, Leeds, 8.

Lock Electric, Ltd. — Registered 5th October. Capital £200. Electrical contractors, engineers, and dealers in all kinds of electrical goods, television, radio, etc. Directors: T. J. B. Lock and Beryl J. Lock. Regd. office: 106, High Street, Coleshill, Warwickshire.

Crowstone Electrical Products, Ltd.—Registered 30th October. Capital £500. Electrical equipment specialists, etc. Directors: A. L. White, L. B. White and Mrs. Eleanor Ridding. Regd. office: 297, Victoria Avenue, Southend-on-Sea.

Chiltern Electrics, Ltd.—Registered 28th October. Capital £1,000. Manufacturers and repairers of, agents for and wholesale and retail dealers in artificial lighting apparatus, electrical plant and machinery, etc. N. J. Ward is the first director. Regd. office: 2, Church Road, Stanmore, Middlesex.

Peltier Cooling Devices, Ltd.—Registered 28th October. Capital £100. Research work in the field of thermo-electricity and its application to refrigeration, etc. Directors: H. G. De Laszlo and E. A. Haslam. Regd. office: 15, Cromwell Road, S.W.7.

Increases of Capital

Berry's Electric Magicoal, Ltd.—Increased by £165,000, in 5s ordinary shares, beyond the registered capital of £435,000.

Thorn Electrical Industries, Ltd.—Increased by £676,875, in 5s ordinary shares, beyond the registered capital of £2,317,500.

Bankruptcies

R. C. Matthews, 45, Station Road, Seaham Harbour, cycle and electrical dealer.—Receiving order made 2nd November on debtor's own petition. Public examination 13th January at the Court House, John Street, Sunderland.

S. G. Cottle, trading as Electro Products at 218, High Road, Willesden, London, N.W.10.—Trustee, Mr. J. T. Morgan, 100, Park Street, London, W.1, appointed 2nd November.

G. S. Burchill and **R. F. Morgan**, trading in co-partnership as electrical engineers under the style of Burchill & Morgan, from 54, Wells Road, Bristol.—Trustee, Mr. G. C. Ehlers, 28, Baldwin Street, Bristol, 1, appointed 6th November.

J. G. Wadsworth, trading as the Nene Road Electrical Co., at 10, Westfields Terrace, Higham Ferrers, Northants., formerly carrying on business at Nene Road, Higham Ferrers, electrical engineer and motor accessories dealer.—Last day for receiving proofs for dividend 25th November. Trustee, Mr. C. A. Taylor, Official Receiver, 6, The Parade, Northampton.

E. V. Williams, electrician, 5, Clevedon Passage, Stoke Newington, London, N.16.—First and final dividend of 1s 3½d in the £, payable on and after 25th November at Bankruptcy Buildings, Carey Street, London, W.C.2.

L. G. Brown, lately carrying on business at 31a, Colin Road, Luton, dealer in household and electrical equipment.—First and final dividend of 12s 9d in the £, payable on and after 26th November at the offices of Poppleton & Appleby, 4, Charterhouse Square, London, E.C.1.

COMPUTER LANGUAGE

Although instruction simplification has long been achieved in the scientific field, the development of a similar computer language for commercial use has been handicapped by the lack of a suitable business terminology. As a result of an analysis of a large number of commercial problems, International Business Machines, Ltd., have now been able to construct a language in which these problems can be studied in terms of 15 basic computer functions. This language, called "commercial translator," consists of normal English words which will be converted inside the computer into detailed machine instructions. It can be used with the larger existing IBM computers and will be compatible with future IBM computers. Even a person completely unfamiliar with computer programming can be trained to use the new language in a matter of days.

PARLIAMENTARY REPORT

ASKED by Mr. Grimond if he would set up an inquiry into the methods of financing the nationalised industries and dealing with their fixed charges and accumulated deficits, Mr. Heathcoat Amory, the Chancellor of the Exchequer, said that the Radcliffe Committee had made certain recommendations which the Government had under consideration. These industries had no prior charges as such, since they were wholly financed by fixed interest capital. If powers were needed to finance any deficit the Government must naturally seek them from Parliament, but he doubted the necessity for a special inquiry.

Questions on the Nationalised Industries

Mr. McMillan asked the Prime Minister if he would issue new instructions to the Ministers responsible for nationalised industries to the effect that they were no longer to refuse to answer questions on day-to-day administration as a matter of policy. Mr. Macmillan said it was proposed to have discussions about the general question of the relationship between the nationalised industries and Parliament with those concerned. Until these consultations had been completed it would be a mistake to alter the present arrangements.

Television Definition Standards

Mr. Woodburn asked the Postmaster General whether he was aware that failure to settle the final line definition was holding up progress in receiver design and colour television; and whether he could state when Britain would adopt the 625-line standard. Mr. Bevins said he was assured that progress in receiver design in general was not static in Britain; some 625-line receivers were being exported. As for colour television, the main problem was still the development of an economic and reliable colour tube. This was not dependent for its solution on a decision on definition standards. He had not yet received the report of the Television Advisory Committee but the advice given by the committee would have to be studied very carefully, together with the economic and other aspects of television development, before a decision could be made.

Exports Publicity Council

Mr. Maudling, President of the Board of Trade, stated that he had decided to set up an Exports Publicity Council to help exports by improving publicity overseas. He had invited to serve on the Council representatives of industry and of the publicity media. The Council's terms of reference would be "to keep under review publicity and information, both official and unofficial, in support of British exports, and to advise on the markets, media and industries where increased publicity efforts, whether permanent or temporary, seem most likely to be of value; to give advice on all other matters referred to it in the field of export publicity; and to receive reports about the action taken on its recommendations."

Power from Dounreay

Asked about the possibility of the power available from the nuclear station at Dounreay, Scotland, being used for industrial development in Scotland, the Secretary of State for Scotland, Mr. Maclay, said Dounreay was primarily a research and development establishment. He understood that the amount of electricity produced was likely to be small. Any surplus would be available to the North of Scotland Hydro-Electric Board.

Disposal of Radioactive Waste

An expert panel appointed at the request of the Minister of Housing and Local Government by the Radioactive Substances Advisory Committee recently reported on the disposal of radioactive wastes (Cmd. No. 884, H.M. Stationery Office, price 2s 6d).

The panel recommended central control because, apart from special provisions which apply to the Atomic Energy Authority, existing controls governing disposal of radioactive wastes are the same as those governing ordinary wastes. While some release of radiation is inevitable in the development of nuclear power and research and the industrial use of radioactive materials, wastes can generally be disposed of by methods commonly in use by sewerage and sanitary authorities for the disposal of ordinary wastes, provided always that adequate precautions are taken. Local disposal of wastes can safely continue in many instances, thus avoiding the risk of increased exposure through multiple handling. Other methods—e.g. dumping at sea or burial at specially selected sites—may be employed where local disposal is not prudent.

The Government has accepted the panel's recommendations in principle and is giving effect to them in the Radioactive Substances Bill published last week. The Bill replaces certain powers now held by local bodies and provides in appropriate cases for consultation with and supply of information to local authorities on the whereabouts of radioactive materials and on methods of disposal. There will be a register of users of radioactive materials (other than the A.E.A. and licensed nuclear installations) so as to impose a control at source. Registration in itself is not an authorisation to dispose; each undertaking, once registered, must submit its proposals for disposing of radioactive waste and get them authorised.

Blood Pressure Follower

AN electronic-pneumatic equipment providing a continuous record and control of human blood pressure was demonstrated recently in London. Designed, in conjunction with Dr. J. H. Green of the Department of Physiology at the Middlesex Hospital Medical School, by Winston Electronics, Ltd., the instrument causes minimum discomfort to the patient by the use of a finger cuff instead of the conventional arm cuff or arterial cannulation. It records pressure continuously by a dial in the front panel, a mercury sphygmomanometer and on a heat-sensitive chart calibrated from 0 to 300 mm Hg, and it can automatically control the flow of hypo- and hyper-tensive drugs into a patient to maintain the blood pressure within prescribed limits.

In the Winston-Green blood pressure follower, the arterial pulsation from the digital artery of a finger or toe is detected by a piezo-electric crystal. Signals from this transducer are passed through a two-stage balanced amplifier having a gain of 2,000, followed by a twin T filter to remove any 50 c/s component. After detection, positive pulses are used to cut off a thermionic valve which has a solenoid valve in its anode circuit. This solenoid valve controls the flow of air from a small compressor to a finger cuff which occludes the artery near the transducer.

When blood flow ceases no signals are produced by the transducer and the solenoid valve is energised, cutting off the air supply. A graduated leak allows the cuff to deflate until pulses re-appear, when air is again allowed into the cuff. The cuff is thus maintained at the same pressure as that in the artery and a gauge measuring the cuff pressure gives a direct indication of the blood pressure, while a sufficient blood flow occurs to allow the normal exchange of tissue fluid, nutrition and metabolites to continue.

An electrical meter in series with the solenoid valve provides pulse indication. Any pressure variation outside pre-set maximum and minimum permissible pressures is shown on indicator lights or through audible alarms connected to the output sockets, while with the addition of solenoid valves the equipment may be used to regulate the flow of drugs being drip fed into the patient, the infusion continuing only while the patient's pressure is within the pre-set limits.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 6d each including postage) are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2

1948

5538. Fortescue, P.—Heat exchange systems, particularly for nuclear reactor fuel elements. 19th February, 1949. (823762.)

1952

4010. Marconi's Wireless Telegraph Co., Ltd.—Radio speed indicating installations for aircraft. 3rd October, 1952. (824320.)

1954

29708. Young, H. E.—Electrically operated ignitors of gas burning appliances. 16th January, 1956. (823687.)

30398. Thorn Electrical Industries, Ltd. —Apparatus embodying electroluminescent devices. 21st October, 1955. (Cognate application 31395, 29th October, 1954.) (824242.)

37083. Murphy Radio, Ltd.—Automatic control of colour television receivers. 22nd December, 1955. (823764.)

1955

241. British Telecommunications Research, Ltd.—Phase modulators. 21st December, 1955. (824246.)

1398. Submarine Cables, Ltd.—Electric cable entry glands. 17th January, 1956. (823927.)

3289. Electric & Musical Industries, Ltd. —Electrical signal generating apparatus employing a pick-up tube having a photoelectrically conductive target. 6th February, 1956. (823842.)

6119. Electric & Musical Industries, Ltd. —Circuits embodying television pick-up tubes. 16th February, 1956. (824248.)

8320. Ericsson Telephones, Ltd.—Gaseous electric discharge devices. 15th March, 1956. (823843.)

9007. Metropolitan-Vickers Electrical Co., Ltd.—Travelling wave electron discharge tubes. 28th March, 1956. (823780.)

10009. Land Pyrometers, Ltd.—Voltmeters, temperature indicators, and temperature controllers. 28th March, 1956. (823844.)

21929. English Electric Co., Ltd.—Electric motor control systems. 27th July, 1956. (824104.)

25809. Elemelt, Ltd.—Electrodes for glass melting furnaces. 3rd September, 1956. (823769.)

26027. Pye, Ltd.—Transistors. 11th September, 1956. (824255.)

26887. British Thomson-Houston Co., Ltd.—Brazing of high melting point metals. 20th September, 1956. (824256.)

27235. Metropolitan-Vickers Electrical Co., Ltd.—Magnetic amplifiers. 18th December, 1956. (823693.)

28882. A.E.I.-Hotpoint, Ltd.—Terminal connection for sheathed wire heating elements. 9th October, 1956. (823770.)

29954. Hammond, V. J.—Ultrasonic delay lines. 18th October, 1956. (823846.)

30159. Philips Electrical Industries, Ltd. —Speech transmission systems. 21st October, 1955. (824259.)

30965 and 35192. Decca Record Co., Ltd. —Picture transmission systems. 18th January and 7th June, 1957. (823681/2.)

31813. Farish, T. G., and Gauntlett, L. S. —Tapping connectors for electrical power distribution systems. 18th December, 1956. (Cognate application 32747, 16th November, 1955.) (824260.)

32195. Philips Electrical Industries, Ltd. —Method of retaining part of the core-wire material within a filament helix wound around the core. 10th November, 1955. (823695.)

32256. Ferranti, Ltd.—Transducers. 11th December, 1956. (823847.)

32793. Philips Electrical Industries, Ltd. —Methods of tuning klystrons to a fixed frequency, and klystrons thus tuned. 16th November, 1955. (823601.)

36207. Siemens & Halske A.G.—Housings for electrical components. 16th December, 1955. (824265.)

36645. N.S.F., Ltd.—Electric switch mechanisms. 21st December, 1955. (823697.)

37123. British Thomson-Houston Co., Ltd.—Electric rectifier arrangements. 26th March, 1957. (824172.)

1956

1291. Sebel S.A.—Electronic illuminating lamps. 13th January, 1956. (823942.)

2007. Compagnie Française Thomson-Houston.—Ultra-short wave equipment. 20th January, 1956. (823700.)

2348. Sangamo Weston, Ltd.—Electrical apparatus incorporating printed or etched circuits. 24th January, 1956. (823772.)

2600. Igranic Electric Co., Ltd.—Control systems for electric reel motors. 26th January, 1956. (824173.)

4410. Metallic Flowers, Inc.—Devices for generating and transferring thermoelectric power effects to the human skin. 13th February, 1956. (823946.)

4606. General Electric Co.—Crystal filters. 14th February, 1956. (823853.)

5049. Sangamo Weston, Ltd.—Electrical instruments of the moving coil type. 17th February, 1956. (824288.)

5657. Robertshaw-Fulton Controls Co.—Electric heater assemblies. 23rd February, 1956. (823775.)

7583. Chromatic Television Laboratories, Inc.—Display screens for cathode-ray tubes. 12th March, 1956. (824294.)

8984. General Electric Co.—Wire having an electrically insulating crating of solid polytetrafluoroethylene. 22nd March, 1956. (824296.)

9124. Prochazka, M.—Electromagnetic vibrator, more particularly for testing turbine blades. 23rd March, 1956. (824179.)

9156. General Electric Co.—Resin casting for the manufacture of dynamo-electric machine housing parts. 23rd March, 1956. (823781.)

9210. Postmaster General.—Echo waveform correctors. 22nd March, 1957. (823608.)

9486. Parsons & Co., Ltd., C. A.—Heat exchangers. 15th March, 1957. (823951.)

12854. General Electric Co.—Production of colour images. 26th April, 1956. (823783.)

12914. Decca Record Co., Ltd.—Electrical resistance elements. 17th April, 1957. (824307.)

13243. General Electric Co., Ltd.—Manufacture of ferrites. 30th April, 1957. (824310.)

13831. Igranic Electric Co., Ltd.—Grid-type resistance units. 4th May, 1956. (823860.)

14400. Igranic Electric Co., Ltd.—Electrical control systems for machines. 9th May, 1956. (823710.)

14728. Metropolitan-Vickers Electrical Co., Ltd.—Heating apparatus. 8th May, 1957. (823959.)

15061. International Business Machines Corporation.—Junction transistor. 15th May, 1956. (823784.)

15758. Kienzle Apparate G.m.b.H.—Output arrangements for electronic counters. 22nd May, 1956. (824187.)

16023. Ciba, Ltd.—Fume-proof electric switch device. 23rd May, 1956. (824117.)

17010. General Electric Co.—Electrical circuit arrangements utilising ferromagnetic cores. 1st June, 1956. (824190.)

17802. Standard Telephones & Cables, Ltd.—Electric pulse modulating and demodulating circuits. 7th June, 1957. (824221.)

17994. Sumitomo Electric Industries, Ltd.—Insulated electric conductor for communication cables. 11th June, 1956. (823787.)

18034. Siemens-Schuckertwerke A.G.—Directional relay devices. 11th June, 1956. (824322.)

19126. Lincoln Electric Co.—Electric arc welding apparatus. 20th June, 1956. (823963.)

20199. Fernseh G.m.b.H.—Television cameras. 29th June, 1956. (824329.)

20243. General Electric Co.—Voltage stabilising circuits. 29th June, 1956. (824326.)

20310. Soc. des Accumulateurs Fixes et de Traction.—Voltage control devices. 29th June, 1956. (824123.)

20419. British Thomson-Houston Co., Ltd.—Electric contact brushes. 18th June, 1957. (823964.)

20422. General Electric Co., Ltd., and Glover, B. W.—Electrical frequency dividing circuits. 2nd July, 1957. (823716.)

20423. General Electric Co., Ltd.—Dynamo-electric machines. 1st July, 1957. (823788.)

20903. British Thomson-Houston Co., Ltd.—Rotary switch operating means. 4th June, 1957. (823717.)

21691. Wörner, A., and Ersing, M. (trading as Kautt & Bux).—Actuating mechanism for electric switches. 13th July, 1956. (823718.)

23884. Siemens Edison Swan, Ltd.—Automatic telephone and like selective systems. 16th July, 1957. (824336.)

24171. Philips Electrical Industries, Ltd. —Ferromagnetic ferrite materials. 7th August, 1956. (823971.)

25283. General Electric Co., Ltd.—Methods of forming a junction in a semiconductor. 16th August, 1957. (823612.)

26427. Wood, J. F.—A.c. power sources. 29th August, 1956. (824126.)

27619. Compagnie Française Thomson-Houston.—Potentiometer arrangement for translating a function with two independent variables into an electric valve. 10th September, 1956. (824343.)

27928. General Electric Co., Ltd.—Telephone handsets. 12th September, 1957. (824235.)

28143. Standard Telephones & Cables, Ltd.—Electric pulse modulating and demodulating circuits. 7th June, 1957. (Divided out of 824221.) (824222.)

29116. Cohen, E., and Roth, S.—Flame-proof eddy-current coupling. 24th September, 1956. (823977.)

29703. General Electric Co.—Electric translation apparatus. 28th September, 1956. (824128.)

29848. General Electric Co., Ltd.—Thermo-electric devices. 30th September, 1957. (824347.)

30181. General Electric Co., Ltd.—Manufacture of glass envelopes. 3rd October, 1957. (824231.)

30183. General Electric Co., Ltd.—Article-supporting apparatus. 3rd October, 1957. (824232.)

30404. Fernseh G.m.b.H.—Colour television apparatus including frequency changing apparatus. 5th October, 1956. (823981.)

30646. General Electric Co., Ltd.—Manufacture of transformers. 8th January, 1958. (823725.)

31448. Soc. Gramme, and Trottier, J. E. —Electric power plant for marine propulsion. 16th October, 1956. (823798.)

Continued overleaf

NEW PATENTS (*continued*)

32308. Crompton Parkinson, Ltd.—Electric arc stud welding. 10th October, 1957. (Cognate application 8478, 14th March, 1957.) (823614.)

33955. Communications Patents, Ltd.—Reception of television transmissions. 15th January, 1958. (823867.)

34387. Siemens & Halske A.G.—Semiconductor devices and circuit arrangements including such devices. 9th November, 1956. (823987.)

34948. Marconi's Wireless Telegraph Co., Ltd.—Wide band high frequency transformers. 29th July, 1957. (823804.)

35670. Landis & Gyr A.G.—Apparatus for superimposing audio-frequency control impulses on energy distribution system. 21st November, 1956. (824364.)

35844. Westinghouse Air Brake Co.—Pulsation dampening or surge absorbing apparatus. 23rd November, 1956. (824365.)

37524. General Electric Co., Ltd., and Speed, R. F. B.—Electrical signal generators. 9th December, 1957. (824352.)

37713. Cibie, L.—Electromagnetically operated switching devices for circuits fed by shunt-wound dynamos. 10th December, 1956. (824372.)

38923. General Electric Co., Ltd.—Nuclear reactor arrangements. 17th December, 1957. (824377.)

1957

71. Sperry Rand Corporation.—Electromagnetic signal generators. 1st January, 1957. (823808.)

1609. Imperial Chemical Industries, Ltd.—Electrical temperature control device. 1st January, 1958. (824385.)

1713. British Aluminium Co., Ltd.—Solid electric current conductors for use in contact with molten aluminium. 14th January, 1958. (824202.)

1823. Hilger & Watts, Ltd.—Polarimeters and like apparatus. 17th January, 1958. (Cognate application 18257, 7th June, 1957.) (824386.)

2630. Messen-Jaschin, G. A.—Electrostatic precipitators. 24th January, 1957. (824005.)

3977. Bendix Aviation Corporation.—Electric regulator. 5th February, 1957. (823738.)

4255. Siemens & Halske A.G.—Circuit arrangements for operating rotary selectors in telecommunications installations. 7th February, 1957. (824395.)

5457. British Telecommunications Research, Ltd.—Pulse distortion detecting equipment. 5th February, 1958. (823874.)

7589. Mullard, Ltd.—Apparatus and method for affixing electric components. 5th February, 1958. (824020.)

8287. Metropolitan-Vickers Electrical Co., Ltd.—Electric bushing insulators. 25th February, 1958. (823812.)

9639. Chloride Electrical Storage Co., Ltd.—Separators for lead acid electric accumulators. 13th January, 1958. (824025.)

9718. British Thomson-Houston Co., Ltd.—Low frequency electrical generators. 25th March, 1958. (824211.)

11092. Telefonaktiebolaget L. M. Ericsson.—Electrical condenser arrangements for the reduction of sparking between electrical contacts. 4th April, 1957. (823815.)

11463. Volex Electrical Products, Ltd., and Hughes, J. G. K.—Electric tumbler switches. 8th April, 1958. (824030.)

13562. Servomechanisms, Inc.—Metallic film adjustable resistor and contact brush therefor. 29th April, 1957. (824234.)

13908. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler.—Fuel element for nuclear reactors. 1st May, 1957. (824034.)

14387, 14505 and 14525. Scully Signal Co.—Electrical fail-safe system. 6th May, 1957. (823880/1/2.)

14743. Sperry Rand Corporation.—Magnetic amplifier circuits. 9th May, 1957. (824036.)

21794. Cooper-Stewart Engineering Co., Ltd., and Robson, C. W.—Electrical pulse generating apparatus. 9th July, 1957. (Divided out of 817795.) (823756.)

22057. Marconi's Wireless Telegraph Co., Ltd.—Navigation aiding radio receiving installations. 13th March, 1958. (823825.)

22424. Mauduech, R.—Phase modulating devices. 15th July, 1957. (823826.)

23253. United States Atomic Energy Commission.—Method and apparatus for nuclear reactor safety control. 23rd July, 1957. (823672.)

23920. National Rejectors, Inc.—Timing device for electric switches. 29th July, 1957. (823757.)

26155. Sunbeam Corporation.—Controlled electrically heated cooking vessel. 19th August, 1957. (823678.)

26449. Materiel de Cablerie, and Andouart, L.—Machines for furnishing electric wires with a multi-coloured plastic covering. 21st August, 1957. (823679.)

32520. Svenska Relafabriken A.B.—Telecommunication systems. 17th October, 1957. (823655.)

32918. General Electric Co.—Magnetic amplifiers. 22nd October, 1957. (823898.)

35059. Philips Electrical Industries, Ltd.—Methods and apparatus for applying electron emissive coatings to cathode cores of indirectly heated thermionic cathodes. 11th November, 1957 (823900.)

38841. Standard Telephones & Cables, Ltd.—Electric signalling and computing systems. 13th December, 1957. (823830.)

39481.—Nordiska Armaturfabrikerna A.B.—Methods of preparing coils for high frequency induction furnaces and mounting the coils in the furnaces. 19th December, 1957. (823905.)

39498. Bosch, G.m.b.H., R.—Apparatus for the calibration of a photo-electric reflection meter. 19th December, 1957. (823832.)

1958

710. Standard Telephones & Cables, Ltd.—Channel combining arrangements for multichannel carrier systems. 8th January, 1958. (823833.)

9538. General Motors Corporation.—Starter devices for split-phase electric motors. 25th March, 1958. (823629.)

10369. Wuerth, R. C.—Current limiting device for safeguarding circuit elements from excessive starting currents. 1st April, 1958. (823631.)

14925. Compagnie Générale de Télégraphie sans Fil.—Dielectric ceramic material and the manufacture of such material. 9th May, 1958. (823636.)

20521. United States of America, Secretary of the Army.—Carbon diffusers for gas activated electric batteries. 26th June, 1958. (823918.)

22472. Philips Electrical Industries, Ltd.—Electron discharge tubes. 14th July, 1958. (823919.)

22649. Soc. Elettrotecnica Chemica Italiana S.p.a., and Canegallo, G.—Flexible cords for electrical resistors. 15th July, 1958. (823920.)

TRADE MARK APPLICATIONS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 4th December:—

Skoda (design). No. B774,171. Class 9. Scientific and electrical apparatus and instruments; nautical, surveying, optical, weighing, measuring, signalling, checking (supervision) and teaching apparatus and instruments; calculating machines; and parts.—Zavody V. I. Lenina Plzen, Narodni Podnik, Plzen, Tylova ulice, Czechoslovakia. Address for service, c/o Reddie & Grose, 6, Bream's Buildings, London, E.C.4.

Schulmerich. No. 784,640. Class 9. Radio apparatus, electronic sound amplifiers, loudspeakers; electrical, optical or magnetic apparatus for recording and storing sound signals; etc.—Schulmerich Carillons, Inc., Sellersville, Penn., U.S.A. Address for service, c/o Mathys & Squire, 52, Chancery Lane, London, W.C.2.

Torneco. No. 786,800. Class 9. Electric dust exhausters.—Tornado-France, Paris, France. Address for service, c/o Boult, Wade & Tennant, 112, Hatton Garden, London, E.C.1.

Tungsram. No. 787,544. Class 9. Electric semiconducting devices for use in telecommunications.—British Tungsram Radio Works, Ltd., West Road, Tottenham, London, N.17.

Centurion (design). No. 788,581. Class 9. Lead-acid electric accumulators.—A. E. Clayton, trading as the Centurion Battery Co., 23-25, Oldridge Road, Balham, London, S.W.12.

Sickles. No. 789,341. Class 9. Electrical and electronic apparatus and parts.—General Instrument Corporation, Newark, N.J., U.S.A. Address for service, c/o Haseltine, Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2.

Siera. No. 789,970. Class 9. Electric vacuum cleaners, domestic electric floor polishing machines, electric flat irons, kettles, coffee percolators and parts.—N.V. Siera Radio, The Hague, Holland. Address for service, c/o T. D. Threadgold, Century House, Shaftesbury Avenue, London, W.C.2.

Mullard (design). No. B789,738. Class 9. Radio, telegraphic, telephonic, telephotographic, television, radio-location, intercommunication, cinematographic, high frequency, temperature-controlling and sound transmitting, receiving, reproducing, recording and amplifying apparatus and instruments and parts; remote control apparatus, etc.; electric discharge tubes (not being for lighting purposes), and parts; electric semiconducting devices; electronic apparatus; electrical apparatus and instruments for producing, regulating, measuring, converting, switching, tracing, indicating, rectifying and keeping constant electric current and voltage, and parts; electrochemical apparatus; dark room lamps, photographic flash bulbs, electric accumulators; capacitors, ballasts and starting apparatus for use with electric discharge lamps; electric welding apparatus, electrodes, magnets, magnetic cores, battery chargers, condensers, infra-red and ultra-violet radiation apparatus and lamps, none being for medical or surgical purposes; and electrostatic precipitators; etc.—Mullard, Ltd., Mullard House, Torrington Place, London, W.C.1.

Tellulite. No. 791,997. Class 9. Electrically operated advertising apparatus and parts.—Manifold Electric Co., Ltd., 124, St. Margarets Road, Twickenham, Middx.

Dikon. No. 792,047. Class 9. Cathode-ray tubes and electron discharge tubes (not for lighting purposes).—Day-Impex, Ltd., Progress Works, Brunel Road, Eastwood Industrial Estate, Southend-on-Sea.

Musketeer. No. 792,185. Class 9. Electric batteries, cells, accumulators; radio receivers, television apparatus, etc.—Berec Radio, Ltd., Hercules Place, Holloway, London, N.7.

Liberty Brand (design). No. 785,806. Class 11. Electric fans, and fluorescent lighting fittings.—Industrial Suppliers Cambridge (1958), Ltd., 15a-17, Brecknock Road, London, N.7.

Permabender. No. 789,556. Class 11. Apparatus (not being machines) incorporating electric heating elements and being for use in bending rods, tubes and strips of plastics.—Polypenco, Ltd., 68-70, Tewin Road, Welwyn Garden City, Herts.

Bilux-As. No. 789,791. Class 11. Electric lamps and parts; and lamp reflectors.—Osram G.m.b.H., Berlin-Charlottenburg, Germany. Address for service, c/o Cruikshank & Fairweather, 29, Southampton Buildings, Chancery Lane, London, W.C.2.

NEXT WEEK'S EVENTS

Organisers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

MONDAY, 23rd NOVEMBER

Birmingham.—James Watt Memorial Institute, 6 p.m. I.E.E. South Midlands Electronics and Measurements Group. "Learning Machines," by P. Huggins.

Bristol.—At Gardiner, Sons & Co., Ltd., Broad Plain. I.E.S. Bath and Bristol Centre. "Lighting for Selling—Techniques of Shop and Store Lighting," by R. L. C. Tate.

Cardiff.—At the South Wales Institute of Engineers, 6 p.m. I.E.E. Western Utilisation Group. "Discrimination between H.R.C. Fuses," by E. Jacks.

Chester.—Town Hall, 6.30 p.m. I.E.E. Mersey and North Wales Centre. "Research on the Performance of High-Voltage Insulators in Polluted Atmospheres," by Dr. J. S. Forrest, P. J. Lambeth and D. F. Oakeshott.

Leeds.—At British Lighting Council, 24, Aire Street, 6.15 p.m. I.E.S. Leeds Centre. "Polarised Light and its Applications," by D. L. Smare.

Leicester.—E.M.E.B., Charles Street, 7 p.m. I.E.S. Leicester Centre. "Modern Lighting in Production," by L. E. Gibbs.

Manchester.—Engineers' Club, 6.15 p.m. I.E.E. North Western Centre. Discussion on "Modern Applications of Field Plotting," opened by E. R. Hartill.

Newcastle-on-Tyne.—Neville Hall, Westgate Road, 6.15 p.m. I.E.E. North Eastern Centre. "The Application of Low-Pressure Resins to H.V. Switchgear Designs," by T. R. Manley, K. Rothwell and W. Gray.

Reading.—George Hotel, King Street, 7.15 p.m. I.E.E. District meeting. "An Introduction to Electronic Computers," by R. C. M. Barnes.

Stafford.—Staffs Technical College, 7.45 p.m. I.E.E. North Staffordshire Graduate and Student Section. "Engineering Problems in Railway Modernisation," by J. A. Broughall.

Watford.—Compass Hotel, 8.15 p.m. A.S.E.E. North West London Branch. Film—"Electrical Shop Window of 1959."

TUESDAY, 24th NOVEMBER

Bradford.—Institute of Technology, 6.30 p.m. I.E.E. North Midland Centre. "A System for the Automatic Recognition of Patterns," by Dr. R. L. Grimsdale, Dr. F. W. Sumner, Dr. C. J. Tunis and Dr. T. Kilburn.

Cardiff.—At the South Wales Engineers' Institute, Park Place, 7.30 p.m. Institution of Plant Engineers, South Wales Branch. "The Engineering Applications of Electro-Deposited Metals," by J. W. Oswald.

Carlisle.—Technical College, 7 p.m. I.E.E. North Eastern Centre. "The Provision of Adequate Electrical Installations in Buildings—Multi-Storey Flats and Maisonnettes," by C. A. Belcher.

Chatham.—Medway College of Technology, 7 p.m. I.E.E. London Graduate and Student Section. District meeting. "Electrode Boilers for Industrial Process Work and Off-Peak Thermal Storage Heating Systems," by G. A. Williams.

Coventry.—At the G.E.C., Stoke, 7 p.m. I.E.E. South Midland Graduate and Student Section. Senior chairman's address, by G. F. Peirson.

E.M.E.B. Sports and Social Club, Merrick Lodge, St. Nicholas Street. Coventry Electric Club. Films.

London.—At the Royal Institution, Albemarle Street, W.1, 2.30 p.m. Institution of Chemical Engineers. Symposium on Nuclear Energy. (Under the aegis of the British Nuclear Energy Conference.)

Loughborough.—College of Further Education, 6.30 p.m. I.E.E. East Midland Centre. "Development of High-Voltage Air-Break Circuit-Breakers with Insulated-Steel-Plate Arc Chutes," by F. S. Fay, J. A. Thomas, D. Legg and J. S. Morton.

Maidstone.—Royal Star Hotel. A.S.E.E. East Kent and West Kent Branches. Annual dinner.

Manchester.—Engineers' Club, Albert Square, 6.15 p.m. I.E.E. North Western Supply Group. "Generator/Motor Problems in Pumped Storage Installations," by Dr. J. H. Walker.

College of Science and Technology, 7 p.m. I.E.E. North Western Graduate and Student Section. Annual film evening.

Engineers' Club, 2.30 p.m. Combustion Engineering Association, North Western Region. Brains Trust on "Incentive Schemes for Boiler Operators."

WEDNESDAY, 25th NOVEMBER

Dundee.—The Royal Hotel, 5, Union Street, 10 a.m. Combustion Engineering Association. Discussion on "The Utilisation of Small Coals" and (2 p.m.) "Coal to Oil Conversion."

Glasgow.—St. Andrew's Hall, 7.30 p.m. I.E.E. Scottish Centre. Faraday Lecture, "Electrical Machines," by Professor M. G. Say.

London.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Electronics and Communications Section. "Radio Aspects of the International Geophysical Year," by Dr. R. L. Smith-Rose.

I.E.E. London Graduate and Student Section, 3.20 p.m. Visit to Elliott Brothers (London), Ltd., Boreham Wood, Herts.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Batti-Wallahs' Society. Luncheon. Guest speaker, Mr. Donald Campbell.

At the Institution of Civil Engineers, Great George Street, S.W.1, 5.30 p.m. Institute of Fuel. Melchett Lecture. "Surface: A Common Problem for Research and Engineering in Fuel Technology," by Dr. Ing. P. O. Rosin.

John Adam Street, Adelphi, W.C.2, 2.30 p.m. Royal Society of Arts. "Power Production and Transmission in the Countryside: Preserving Amenities," by Sir Christopher Hinton and Sir William Holford.

1, Birdcage Walk, Westminster, S.W.1, 6 p.m. Institution of Mechanical Engineers. "The Effect of Nuclear Radiation on Engineering Materials," by Prof. A. H. Cottrell.

Newport.—Newport and Monmouthshire College of Technology, 6.45 p.m. Society of Instrument Technology, South Wales Section. "Transistors," by S. S. Goldberg.

Norwich.—Flixton Room, 7.30 p.m. Norfolk Electrical Circle. Annual dinner.

Rotherham.—Technical College, 7 p.m. I.E.E. Sheffield Graduate and Student Section. "The Transistor as a Switch," by J. O. Coekin.

Rugby.—College of Engineering Technology, 6.30 p.m. I.E.E. Rugby Sub-Centre. "Subscriber Trunk Dialling," by D. A. Barron.

Shrewsbury.—Walker Technical College, Oakengates, 7.30 p.m. Institution of Production Engineers, Midlands Region. "The Fabrication of Nuclear Power Plants," by S. H. Griffiths.

WEDNESDAY, 25th NOVEMBER to SATURDAY, 28th NOVEMBER

London.—Royal Horticultural Society's Old Hall, Westminster. International Radio Hobbies Exhibition.

THURSDAY, 26th NOVEMBER

Bath.—Committee Room, S.W.E.B. I.E.E. Bristol Graduate and Student Section, 7 p.m. Students' lecture. "Developments in Lighting," by Dr. F. A. Benson.

Birmingham.—College of Technology, Gosta Green, 6.15 p.m. I.E.E. South Midland Education Discussion Circle. "The Organisation of Courses for Electrical Technicians," by Prof. M. W. Humphrey Davies.

Croydon.—Greyhound Hotel, High Street, 8 p.m. A.S.E.E. South London Branch. "Railway Electric Locomotives," by D. B. McKenzie.

Hove.—New Imperial Hotel, 1st Avenue, 7.30 p.m. A.S.E.E. Brighton, Hove and District Branch. Film—"Electrical Shop Window of 1959."

Kettering.—George Hotel, 7.30 p.m. I.E.E. East Midland Centre. "An Electrical Engineering Project in India," by Major H. E. Knight.

London.—Savoy Place, W.C.2, 5.30 p.m. Institution of Electrical Engineers. Ordinary meeting. "The Application of Low-Pressure Resins to some High-Voltage Switchgear Designs," by T. R. Manley, K. Rothwell and W. Gray.

Porthcawl.—Seabank Hotel, 10.30 p.m. Combustion Engineering Association, Western Region. "The Development of Coal Production and Preparation," by A. W. Davis and (2.15 p.m.) films.

Sheffield.—Grand Hotel, 7.30 p.m. Institution of Plant Engineers, Sheffield and District Branch. "Some Modern Steels for the Engineer," by E. Johnson.

Southampton.—Polygon Hotel, 8 p.m. A.S.E.E. Southampton Branch. "Problems of Ventilation," by J. B. Spokes.

Sunderland.—Technical College, 6.30 p.m. I.E.E. North Eastern Graduate and Student Section. "Ultra-high-frequency Tetrodes," by P. Powers.

Swansea.—Conference Room, S.W.E.B. Showrooms, The Kingsway, 6 p.m. I.E.E. Western Supply Group and West Wales (Swansea) Sub-Centre. "Construction Problems," by R. Lefevre.

Weymouth.—South Dorset Technical College, 6.30 p.m. I.E.E. Southern Centre. Films on "Valve Manufacture, Special Quality Valves and Transistor Manufacture" (with discussion).

FRIDAY, 27th NOVEMBER

Belfast.—College of Technology, 7.30 p.m. Institute of Marine Engineers, Northern Ireland Panel. "Reactor Design, Particularly of Types Suitable for Marine Propulsion," by E. Long.

Birmingham.—Imperial Hotel, Temple Street, 7.30 p.m. Institution of Plant Engineers, Birmingham Branch. "Instrumentation in Industry," by L. F. Cohen.

Cheltenham.—North Gloucestershire Technical College, 7 p.m. British Institution of Radio Engineers, South Midlands Section. "A Vidicon Television Camera Channel," by B. J. Pover.

Coventry.—E.M.E.B. Sports and Social Club, Merrick Lodge, Sandy Lane, 7.45 p.m. A.S.E.E. Coventry and District Branch. Open meeting.

Glasgow.—Bath Hotel, Bath Street. I.E.S. Glasgow Centre. Luncheon meeting.

Halifax.—Crown Hotel, Horton Street, 7.30 p.m. A.S.E.E. Halifax Branch. Annual dinner.

Hanley.—Grand Hotel, 7.30 p.m. A.S.E.E. Stoke and Crewe Branch. "Protective Equipment for Industrial Plant," by Dr. W. L. Stern.

Leicester.—Coronation Hotel. I.E.S. Leicester Centre. Social evening.

London.—Connaught Rooms, W.C.2, 5.30 for 6 p.m. Electrical Power Engineers' Association. Annual dinner-dance.

Savoy Hotel, Strand, W.C.2, 7.15 p.m. for 8 p.m. Institution of Production Engineers, South Eastern Region. Dinner and dance.

Pepys House, 14, Rochester Row, Westminster, 7 p.m. Junior Institution of Engineers. Annual general meeting.

Wolverhampton.—Star and Garter Hotel, Victoria Street, 7.30 p.m. A.S.E.E. Wolverhampton and District Branch. Annual dinner and dance.

SATURDAY, 28th NOVEMBER

London.—Waldorf Hotel. Institution of Plant Engineers, London Branch. Dinner and dance.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses

Australia.—Director, Stores and Contracts, Postmaster General's Department, Melbourne. 10th December. Switchboard parts and accessories. (E.S.B. 26875/59. Ten/43336.)* 14th January. Electricity meters and measuring instruments. (E.S.B. 26694/59. Ten/43273.)*

N.S.W. Electricity Commission, Sydney. 18th January. Two 160 MVA auto-transformers for Vales Point power station and two 160 MVA auto-transformers for Dapto substation. (E.S.B. 26393/59. Ten/43197.)*

Belfast.—Northern Ireland Ministry of Finance. 9th December. Electrical installation at R.U.C. Inspector General's headquarters, Brooklyn, Knock, Belfast. Ministry of Finance, Room 103, Law Courts Building.

Burma.—Electricity Supply Board, Rangoon. 14th December. Transformer auxiliaries, measuring instruments and tools for four substations. (E.S.B. 26765/59. Ten/43301.)*

Durham.—City Council. 30th November. Electrical installation in a new fire station at Newton Aycliffe. County architect, South Street.

India.—Delhi Electricity Department. 2nd December. L.v. switchgear and accessories. (E.S.B. 26805/59. Ten/43323.)*

Director General of Supplies and Disposals, New Delhi. 4th December. Hard drawn copper conductors. (E.S.B. 26853/59. Ten/43322.)*

India Store Department. 17th December. Mains frequency furnace. 21st December. Induction furnace. (See this issue.)

Rihand Hydro-Electric Design Directorate, Kanpur. 28th December. Equipment for Churk substation. (E.S.B. 26818/59. Ten/43320.)*

Iraq.—Directorate General, Passenger Transport Service, Baghdad. 28th November. 1,000 6 V batteries. (E.S.B. 26760/59. Ten/43313.)*

Iraqi Ports Administration, Basrah. 6th December. Electrical decoration materials. (E.S.B. 26992/59. Ten/43364.)*

Korea.—Government Office of Supply, Seoul. 11th December. Equipment including 50 kVA and 100 kVA transformers, and cable. (E.S.B. 26985/59/I.C.A. Ten/43351.)*

Kuwait.—Government Department of Electricity. 2nd December. Cartridge fuses and fuse links. (E.S.B. 26333/59. Ten/43297.)*

Lebanon.—Ministry of Communications, Beirut. 29th December. Multi-channel telephony and telegraphy radio link between Amman and Beirut. (E.S.B. 26504/59. Ten/43283.)*

Llandudno.—U.D.C. 17th December. Class "A" street lighting equipment. (See this issue.)

New Zealand.—G.P.O., Wellington. 11th December. P.v.c. switchboard cables. (E.S.B. 26523/59. Ten/43230.)*

Dunedin Electricity Department. Substation switchgear. (E.S.B. 26705/59. Ten/43312.)*

Nigeria.—Electricity Corporation of Nigeria. 19th December. Fuel storage tanks for Kaduna power station. (See this issue.)

Pakistan.—Water & Power Development Authority, Lahore. 30th November. 11 kV and 63 kV switchboard and equipment, 400 V and 220 V switchboard; 220 V stationary battery, rectifiers and battery switch; 200 kVA transformer, etc., for Daudkhel grid station. (E.S.B. 27102/59/I.C.A. Ten/43389.)*

Government Department of Supply and Development, Chittagong. 30th November. Insulated electric cable. (E.S.B. 27005/59. Ten/43352.)* Cable and accessories. (E.S.B. 27003/59. Ten/43354.)* 3rd December. Cable, joint boxes, sleeves and solder. (E.S.B. 27002/59. Ten/43357.)*

Government Department of Supply and Development, Karachi. 30th November. Wire and copper conductors. (E.S.B. 27103/59. Ten/43390.)*

Portuguese East Africa.—Ports, Railways and Transport Department, Lourenço Marques. 30th November. Lead accumulator batteries and spares. (E.S.B. 26761/59. Ten/43302.)*

Rhodesia and Nyasaland.—Bulawayo Electricity Department. 16th December. 88 kV surge divertors and surge counters. (E.S.B. 26703/59. Ten/43318.)*

Ryton (Durham).—U.D.C. 7th December. Electrical installations in 36 houses at Heddon View. U.D.C. surveyor.

South Africa.—Pretoria Electricity Department. 22nd December. 132 kV, 11 kV and l.v. transformers for Rooiwal power station. (E.S.B. 26777/59. Ten/43304.)*

Sudan.—Central Electricity and Water Administration, Khartoum. 15th December. 11 kV switchgear. (E.S.B. 26732/59. Ten/43274.)*

Posts and Telegraphs Department, Khartoum. 11th January. Underground cable. (E.S.B. 26380/59. Ten/43194.)*

Westhoughton.—U.D.C. 11th December. Street lighting equipment. (See this issue.)

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Middlesbrough.—Tees Valley and Cleveland Water Board. Electrical work in connection with the Lartington filtration works (£1,674).—C. Horne & Co.

Newcastle-on-Tyne.—Regional Hospital Board. Electrical work in connection with alterations to wards at Queen Elizabeth Hospital, Gateshead (£1,287).—Selborne Engineering Co.

Seaham (Durham).—U.D.C. Electrical installations in 92 houses and 12 flats on the Eastlea estate.—Gee & Brown (Electrical Contractors).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors

Aberdeen.—First development at Royal Infirmary, Foresthill (£575,000); regional engineer to Hospital Board, 1, Albyn Place, Aberdeen.

Aylesbury.—Technical college and secondary technical school; F. Pooley, county architect, County Offices, Walton Street.

Bath.—Science block for City of Bath Boys' School; Gerrard, Taylor & Partners, architects, 4/5, Bridge Street.

Three-storey hostel, Green Park; J. Wilkinson, planning officer, 7, North Parade Buildings.

Bedfordshire.—Secondary modern school, Oakley; county architect, Bedford.

Crook (Co. Durham).—Houses (50), Watergate estate; Page, Son & Hill, architects, 75, King Street, South Shields.

Doncaster.—Mental hospital, Crookhill; Sheffield Regional Hospital Board, Fulwood House, Old Fulwood Road, Sheffield, 10.

Office block, Leicester Avenue (£22,000); county architect, Wakefield.

East Ham.—Fashion store for C. & A. Modes, Ltd.; Pauling & Co., Ltd., 26, Victoria Street, S.W.1.

Exeter.—Rebuilding and extending city library (£193,000); H. B. Rowe, city architect, Municipal Offices.

Filey.—Factory; Marshall Bros., Ltd., Ravine Hall.

Great Yarmouth.—Central library, art gallery and lecture hall; Bush Builders, Ltd., Mile Cross Lane, Norwich.

Guildford.—Nine-storey office block, Portsmouth Road; Sir Robert McAlpine & Sons, Ltd., 80, Park Lane, London, W.1.

Havant.—Factory and offices, Downley Road; Hennessey Products, Ltd., 11, South Street.

Hornchurch.—Houses and flats (144), Front Lane, Cranham; clerk of the Council, Council Offices, Billet Lane, Hornchurch.

Ipswich.—Special school, Chantry estate; Johns, Slater & Haward, architects, 32, Foundation Street.

Leicester. — Central swimming baths (£350,000); city architect.

London.—Bank and offices, Fenchurch Street and Gracechurch Street; Whinney, Son & Austen Hall, architects, 37, Norfolk Street, W.C.2.

Showrooms and offices, New Bond Street and Bruton Place; Prudential Assurance Co., Ltd., Holborn Bars, E.C.1.

Block of flats, Belgrave Road, S.W.; E. C. P. Monson, architect, 120, Moorgate, E.C.2.

Loughborough.—Swimming baths, Derby Road (£150,000); borough surveyor.

Manchester.—College of Further Education, Moston; John Laing & Son, Ltd., Dalston Road, Carlisle.

Showrooms and offices, Peter Street; John E. Beardshaw & Partners, architects, 186, Oxford Road.

Works extensions; Saxon Jefferis, Ltd., Wilmslow Road, Didsbury.

Middlesbrough.—Warehouse, offices, and showroom, Cannon Street, for Middleton & Co.; J. C. Lawrence & Co., architects, 63, Brown Street, Manchester, 2.

Second stage of St. Mary's College; Hudson Brothers, contractors, Fidler Street, Middlesbrough.

Northwich.—Development of Lake House Farm site to provide shopping centre; J. B. Birtwistle, surveyor, Whitehall, Hartford, Cheshire.

Oxford.—Extensions (£100,000), Department of Pharmacology, University of Oxford; Gollins, Melvin, Ward & Partners, architects, 15, Manchester Square, London, W.1.

Three-storey departmental store, Market Street, for Marks & Spencer, Ltd.; T. Mayer, staff architect, 82, Baker Street, London, W.1.

Redcar.—Houses and flats (149); F. Gibberd, architect, 19, The Rows, Stone Cross, Harlow, Essex.

Southend-on-Sea.—Works for Industrial Press, Ltd.; Thomas Bates & Son, Ltd., Harold Hill, Romford.

Sunderland.—New premises in East Cross Street; Hallgarth Steel Products (Sunderland), Ltd., Monkwearmouth, Sunderland.

Taunton.—Factory, Priorswood Road; Steel & Glover, Ltd., Glover Street.

Wakefield.—Library headquarters, Balne Lane (£250,000); West Riding county architect, Westfield Road, Wakefield.

Yeovil.—Factory for C. & J. Clark, Ltd., Street; Sir Alexander Gibb & Partners, consulting engineers, Queen Anne's Lodge, London, S.W.1.